the OIL AND GAS JOURNAL

JULY 8, 1957

The Automatic Pipeline

A 16-page section on communication, instrumentation, control, and operation p. 89

What Hurricane Audrey Did to Gulf Coast Oil

p. 69

IN OIL REFINING...
More Processing Vessels
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JOURNAL News Letter

July 8, 1957
Tulsa, Oklahoma

There's been a basic switch in thinking on an imports plan:

You can put this down as nearly certain: Federal control will be a part of the package when federal officials finally resolve a method of curbing foreign oil imports.

Until last week there was strong feeling in Washington for a voluntary plan. Federal controls would be only a whip to encourage compliance. This has suddenly changed now.

Here's the reasoning: The old guard oil companies no longer dominate foreign operations. Many small companies have entered important oil-producing areas. They have large investments for them. This means they would be under terrific pressure to produce and import all the oil they could to get back this outlay as quickly as possible.

The number of companies involved and their conflicting economic interests create a situation similar to that faced by the oil states at the time proration was instituted. Only tight control by a governmental agency could enforce any order.

Best bet for a plan now: A formula based on 1956 import figures. It will be simple. Every importer will be ordered to cut so much and that's that. The order should be out by the end of July.

Rising costs have oil men looking over their own PRICES.

Steel goods went up last week from $6.50 to $15.50 a ton. Equipment costs will be up at least 5 per cent within a few weeks. These are coming in the wake of a 6 per cent increase in wage costs.

Oil producers, naturally, would like to see their own prices rise too. But apparently this is not in the books at this time. Oil production is being throttled back because of soft products demand and pressure from imports. By all standards an oil-price increase is justified.

That PRICE CUT by Atlantic Refining posted for two areas on the Texas Gulf Coast appears to be more of an adjustment than a downward trend.

Atlantic cut price 13 cents for Refugio-area crude and 10 cents for the Corpus area. These areas had received 40 and 35-cent increases last January. The new postings put them back to 27 and 25 cents above last year's prices. That's more in line with the average increase given other areas earlier this year.

The HARRIS GAS BILL this week may move toward a House vote.

Measure is expected to come out of House commerce committee unscathed. Next test will be the rules committee, which passes on all bills headed for the House floor.

One fact is emerging from HURRICANE AUDREY: Oil industry got off light.

Offshore installations and equipment rode out the storm with surprisingly little damage. Worst hit were onshore facilities where tidal waves, and not wind, created most wreckage.

Insurance adjustors now are reporting total damage may not exceed $5 million. But full extent of damage to offices, bases, warehouses, producing wells, etc. may not be known for weeks.

Personal tragedies, however, form another story--and a grim one. The Oil and Gas Journal regional correspondents report from Houston:

"The destruction around Cameron is beyond belief. Tragedy is everywhere. Many of the people lost worked for oil companies--either on offshore rigs and platforms or operating crew boats and tenders.

"Most offshore facilities were evacuated before the storm struck. The men went home to care for their families. No one is sure how many of them made it to safety nor how many will return to drill again."

How deep can DRILLERS go? Is there a limit beyond which we cannot logically expect to find an accumulation of oil and gas in quantity?

Patterns for determining that limit haven't evolved yet. Only restricting factors now are mechanical and economic. Even these are dwindling.

There are many lures to drilling past the 5-mile mark: Presence of 65,000 ft. of drillable sediments in California, 40,000 ft. in the Pacific Northwest and Green River basin, 30.000 ft. in Delaware and Midland basins of Texas.

All this is pointed up by sudden interest in 22,000 ft. wildcats. Two are in the mill now: Phillips has staked one near Fort Stockton, Tex. Kenneth Ellison is rounding out plans for 22,500-ft. test in Oklahoma's Fort Cobb anticline (p. 185).

A rank geological wildcat in South-Central Oklahoma also may be threatening the DEEP-DRILLING record.

Magnolia's 1 Sterba on the south flank of big Cement field in Caddo County is nearing 18,000 ft. It originally was set up for 15,000 ft. When that depth was reached far short of intended Simpson, operator decided to go another 3,000 ft. This was easy since there were no drilling problems.

Now geologists think the Simpson may be as deep as 22,000 ft. and they may send the well on down after it.

New trends are shaping up for drilling operations in Venezuela.

Sinclair's sale of all its drilling equipment in Venezuela to Helmerich & Payne may be a sign of the times. Sinclair now will do its future drilling on a contract basis. Other operating companies are considering doing the same.

This is a switch. A year ago the companies were doing the bulk of

the drilling in Venezuela. Since then contractors have picked up a bigger slice of the business, are now doing about half of the drilling.

With more contractors moving into the field and others studying that possibility, more and more of the drilling work may go to contractors.

Magnolia is moving fast on biggest MISCIBLE-PHASE displacement job yet.

Injection began last month shortly after Texas Railroad Commission approved project for the big 8,160-acre Parks Pennsylvanian unit. Full-scale propane injection will be started within a week or two. Magnolia will use a propane slug chased by gas.

The $3.5 million operation is expected to yield 15 to 20 million extra barrels of oil from the field.

PRODUCTION men will want to follow this closely: The nation's first combination L.P.G. storage and secondary-recovery project is being staged in California by Sunray Mid-Continent Oil Co.

Sunray is using upper Miocene zone in Newhall-Potrero field just north of Los Angeles to test double-barreled possibilities of miscible-phase displacement.

Here's how it will work: Propane will be injected during summer months. The L.P.G. market then is slack. This is expected to double ultimate oil recovery from upper Miocene pay. In winter when propane demand picks up, the propane will be back-flowed through the injection well and sold.

Production engineers note: Conoco is having success with a plunger-lift method using parallel tubing strings.

Device has been field tested for 5 years in San Miguelito and Seal Beach fields in California. The results: Increased production and economy of operation. The second string provides lift gas and keeps pressure off the formation. Another advantage: Method can be used to produce relatively deep wells to their final economic limit (p. 114).

You can look for a new plateau on MOTOR-FUEL OCTANE ratings to result from Ethyl Corp.'s newly announced antiknock additive, AK-33X.

Expect the first commercial use to be in aviation gasoline. It is expected to push existing DC-7's and super constellations into the 400-mph. cruising speed range. That's competitive with turboprop aircraft.

Ethyl wants to study the additive further before making any firm statements on its application to motor-fuel octanes. But prospects look good. AK-33X reportedly is competitive with additional processing aimed at raising motor-fuel octane ratings. But its higher cost will not make it competitive with TEL.

So the additive will be used in conjunction with TEL in both aviation and motor fuels. When so used, it is roughly twice as effective as TEL in raising research octanes.

Makers of TWO-GRADE GASOLINE are putting up a spirited battle for the high-requirement market with the superpremiums.

Nineteen of the two-grade marketers are now selling premium of 99-plus octane. Three more are in the 100-plus category, averaging slightly over 101 octane. The superpremiums range from 100.2 octane to 102.

The battle has brought a .9-octane increase in average premium so far this year. The increase was only 1.2 for all of 1956.

Esso Standard has found a way to reduce the number of spare parts stocked at its Baton Rouge REFINERY. Company has compiled manuals listing parts which are interchangeable. The manuals on gas-engine compressors and centrifugal pumps alone resulted in a $375,000 reduction in spare-parts inventory (p. 133).

A BIG GAS LINE from the Four Corners area to California is being promoted by a new firm--Trans-Western Pipe Line.

Owners are Warren Petroleum, a subsidiary of Gulf; Monterey Oil; and J. B. Butler, Houston consulting engineer. Trans-Western is shooting for 2 trillion cubic feet in reserves and an initial volume of 200,000 M.c.f. daily. Some reserves have been signed up, but construction is at least a year off.

Here's the unusual aspect of the development: It makes Trans-Western squarely competitive with El Paso Natural, a gas-industry giant, for markets and reserves. It's the first instance of majors entering the gas-transmission business, which has limited returns and federal regulation. It provides ready outlet for potential gas acreage held by Gulf and its affiliates.

Plans for a SUEZ PIPELINE paralleling the canal are being hatched by Greek shipping magnate Aristotle Onassis and Egypt's Nasser.

Reported preliminary agreement calls for a 32 or 36-in. line capable of moving 500,000 bbl. daily. Cost would be $86.7 million with Onassis and other European financiers picking up the tab.

Idea back of the line: Allow Onassis' supertankers, which can't now navigate the canal, to avoid the long run around the cape; and beat the jump on rival plans for a line from the Persian Gulf to the Mediterranean through Turkey.

European sources say Onassis-Nasser plans won't stop the line through Turkey. European officials say Suez project still would give Nasser possible strangle hold over oil-supply lines.

Another MAJOR PIPELINE to move natural gas from Alberta into the United States already is being talked.

Alberta gas executive Dennis K. Yorath predicts the project will get started within 5 years and the line will run as far south as California.

Canada's third major gas outlet--from Savanna Creek field to Idaho--meanwhile may be completed in 1958. Westcoast Transmission officials are optimistic about getting governmental approval for the 30-in line. The 174-mile artery would connect with a Pacific Northwest line from Spokane to Idaho border.

Polyethylene tape is gaining increased use as a material to protect big-inch steel pipelines against corrosion. The Houston Texas Gas & Oil system from Baton Rouge to Miami will become the first entire system to be wrapped with this material.

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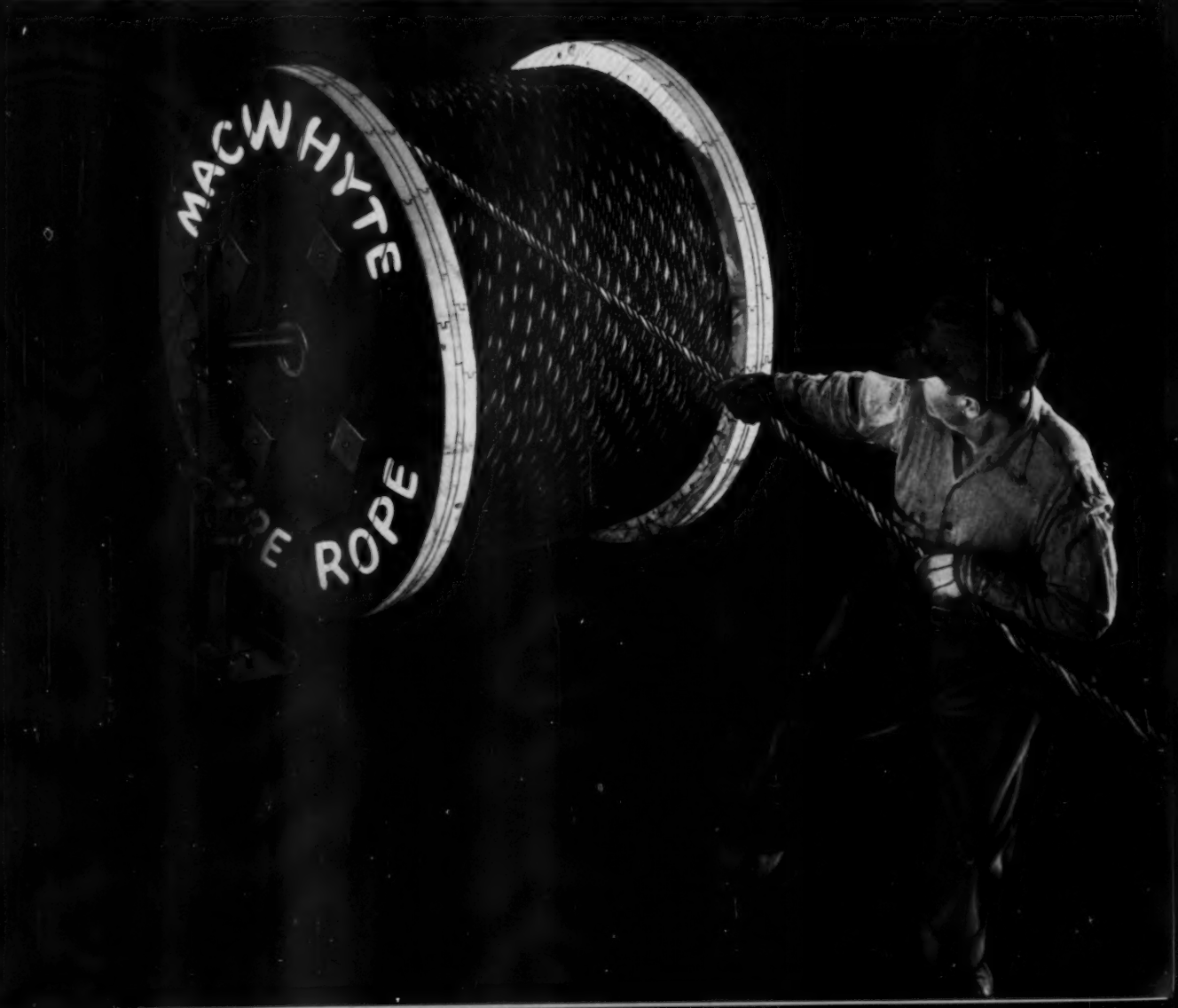

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OIL AND GAS PIPELINES • REFINING • PETROCHEMICALS
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TECHNOLOGY–OPERATION

Pipelining

SPECIAL SECTION: THE AUTOMATIC PIPELINE 89-104

By Max T. Nigh

The automatic pipeline has been in the making for 30 years, ever since the first unattended pump station was built. Automation in one form or another is being relied on increasingly to handle a growing job of transporting petroleum and natural gas economically and efficiently. The automatic pipeline has been put together little at a time, and now the whole is complete —save for one final part. Remote-controlled stations have become commonplace. The next chasm to be bridged is from remote control to a completely self-controlled system. This will mean turning over the chief dispatcher's decisions to a computer, which up to now has done almost everything with a pipeline but run it.

Pipeline Patrol: Construction Report 147

Refining-Processing

Analog Computers for Process Calculations 121

By Warren Jackson, Jr.

Sohio's process engineering division has had a medium-size general-purpose computer in operation for somewhat over a year. This process simulation tool has proved useful in several applications, and others are being studied.

Progress Report: Petrochemicals in Britain 126

In 1956 the United Kingdom output of petroleum chemicals was running at an annual rate of 400,000 long tons. The units of which the industry is composed include plants operated both by chemical companies and oil companies. Recently there has been a pronounced tendency for oil and chemical concerns to form joint companies to promote petrochemical ventures.

On The Job . . . In The Plants 133

Parts interchangeability manuals have helped reduce the volume of spare parts at Esso Standard's Baton Rouge refinery. They have also contributed to an orderly and economical procedure for the procurement of new parts. The manuals have been drawn up on gas-engine compressors and centrifugal pumps.

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COST-imating 141

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Refiner's Notebook 144

Drilling-Production

Progress Report: How Are Turbodrills Performing? 106

By J. A. Mitchell

Dresser's turbodrills have now logged over 13,000 ft. of hole in the first phase of a planned evaluation program. This program is directed toward field testing of various sizes and types of turbodrills for the purpose of establishing operating procedures and verifying turbodrill characteristics in American conditions. Hole sizes have ranged from 7⅞ to 17½ in. Main problem so far is poor bit performance. Penetration rates are 2½ to 3 times those for comparable rotary drilling. Under some conditions, lower drilling costs result with the turbodrill.

Dual-String Plunger Lift is Paying Off 114

By L. J. Tomlinson

A plunger-lift method which uses parallel tubing strings has been successfully field tested by Continental Oil in San Miguelito and Seal Beach fields. As much as 5 years' experience in low-volume wells indicates the method can be used to produce relatively deep wells to their final economic limit. The equipment is installed in 54 wells in these two fields. In most cases fluid is being lifted from depths below 6,000 ft. Wells with a net oil output as small as 8 bbl. daily are produced with low injected gas-oil ratios.

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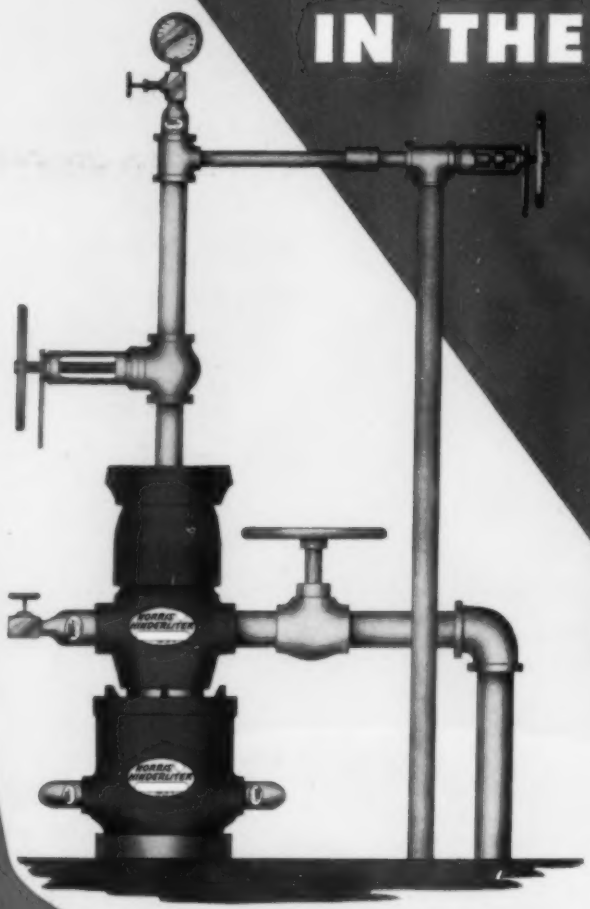
Finest

IN THE FIELD



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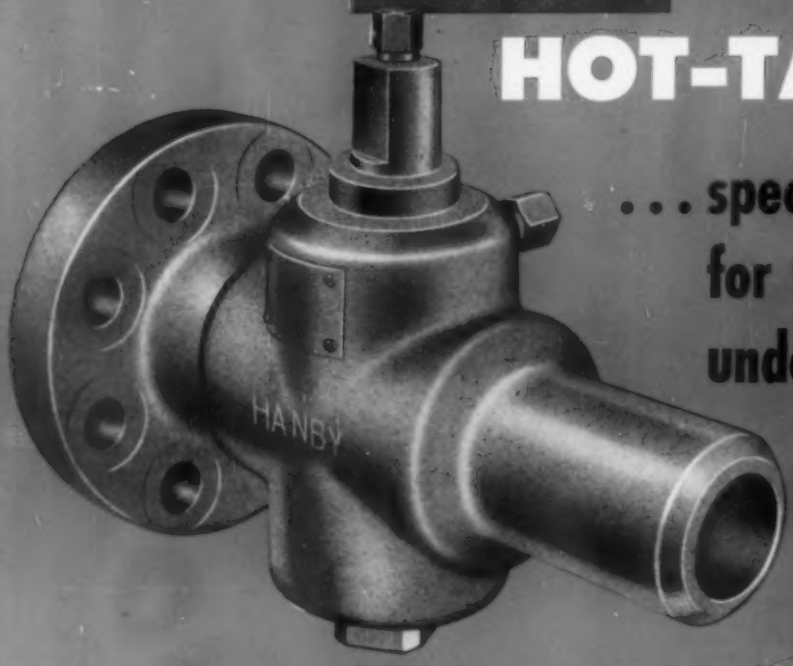

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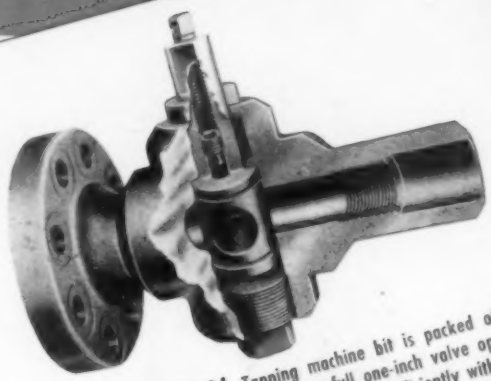

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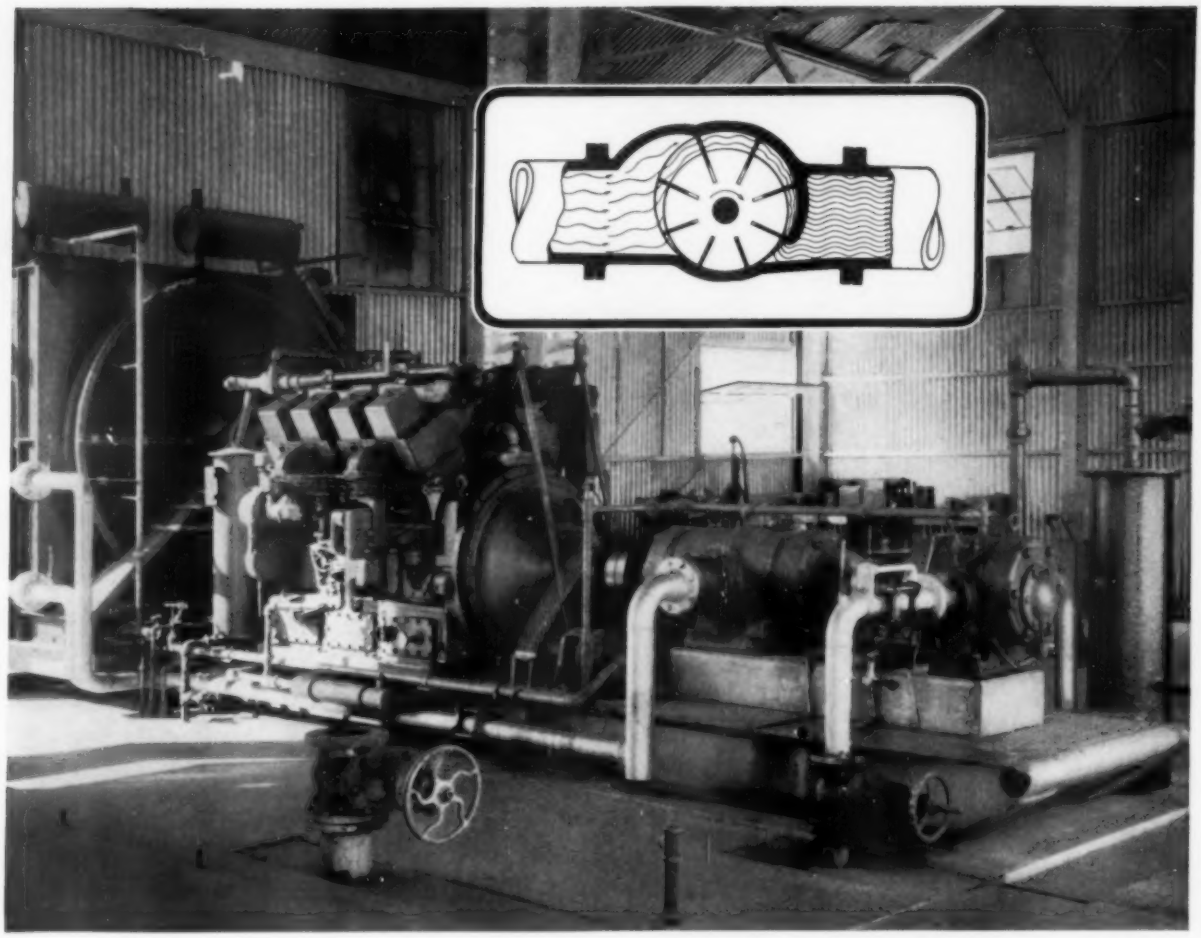

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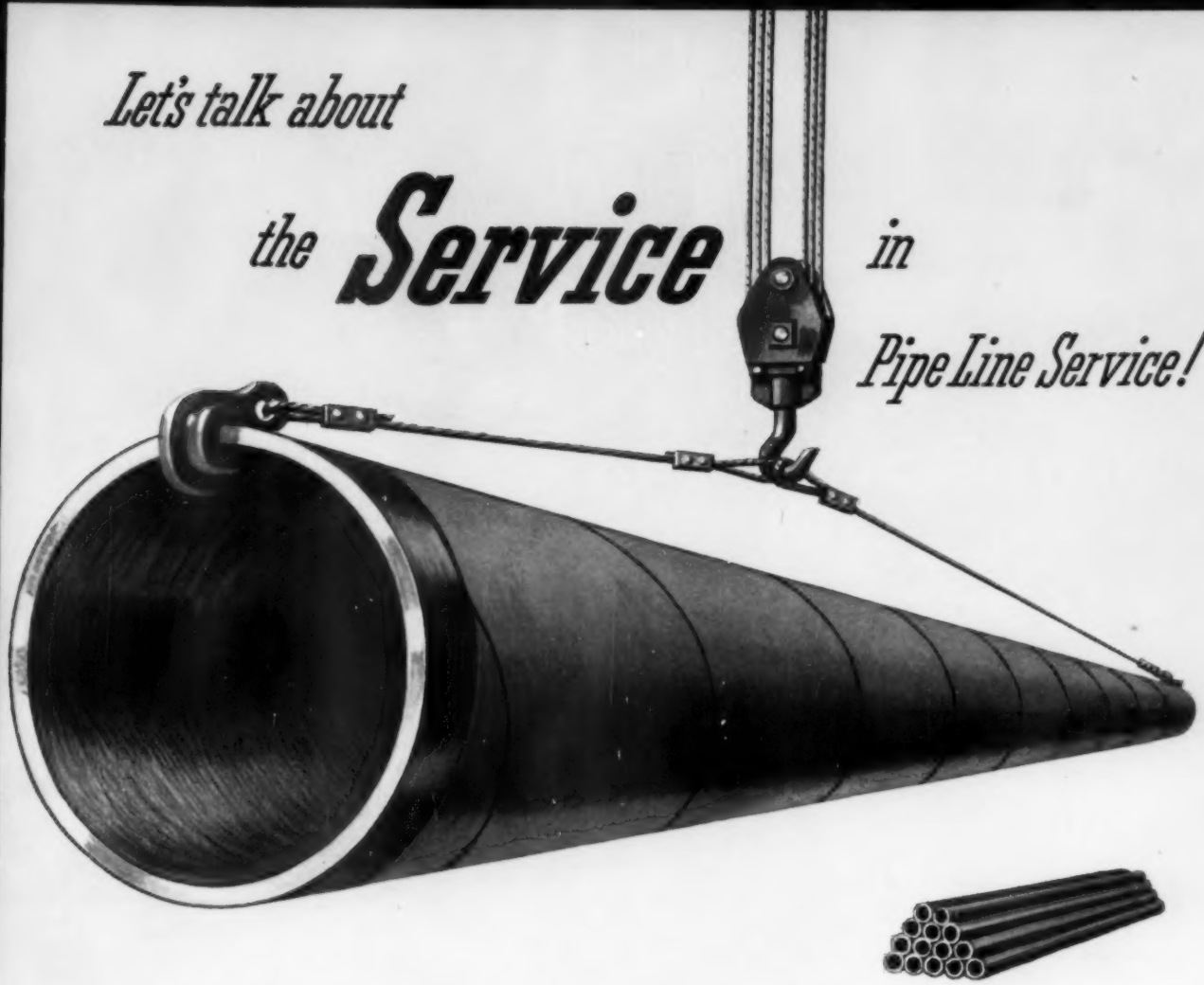

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High on the list of American business achievement stands the swift efficient movement of millions of tons of material – made possible by an endless variety of automatic, time-and-labor saving machinery. Petroleum plays a vital role in this development. In the hydraulic cylinders of lift trucks, for example, move petroleum liquids that revolutionized the art of fast, cost-controlled distribution. Texaco scientists pioneered in creating these amazing hydraulic fluids which change pounds of pressure into tons of lift. The chemical sinews of these liquid muscles are the result of a partnership of research and industry in which Texaco scientists daily seek the new way, the better way.

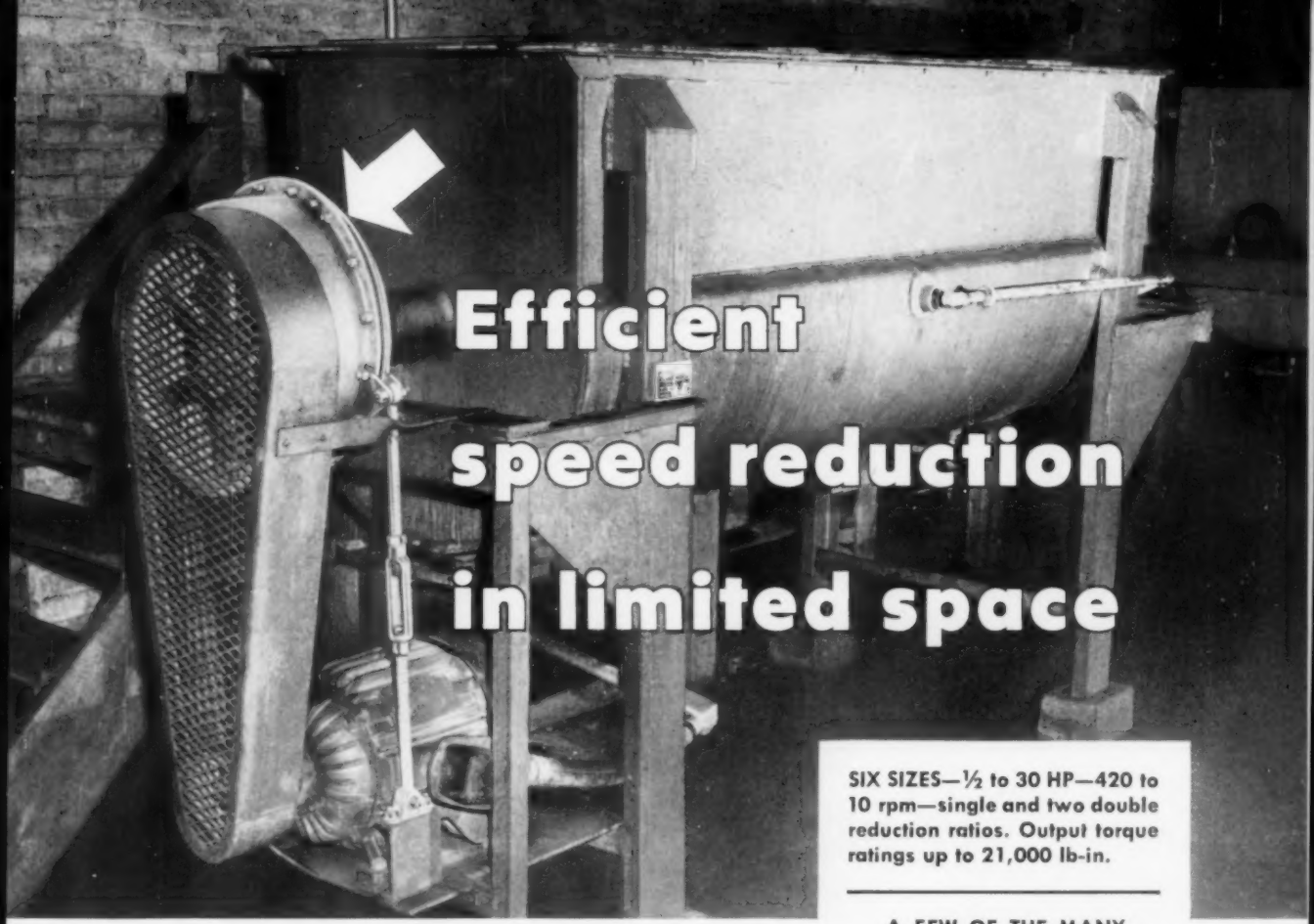
THE TEXAS COMPANY

TEXACO

REG. T.M.

TEXACO

Progress...at your service



Efficient speed reduction in limited space

SIX SIZES—½ to 30 HP—420 to 10 rpm—single and two double reduction ratios. Output torque ratings up to 21,000 lb-in.

FALK ALL-STEEL Shaft Mounted Drives

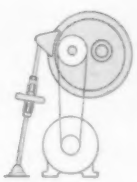
Wherever you require a highly efficient, economical speed reducing unit to fit into a limited space, the FALK All-Steel Shaft Mounted Drive meets your needs perfectly. This rugged, compact reducer mounts directly on the driven shaft and is driven through V-belt or chain drive from any convenient rotating power source.

It's hard to match the versatility of a Falk Shaft Mounted Drive. You can choose a single or double reduction unit and use it with any of the many possible sheave or sprocket ratios to obtain almost any specified speed between 420 and 10 rpm. Equally important, the standard Falk Shaft Mounted Drive is available for horizontal and vertical application. Delivery is immediate, installation is quick and easy.

These units are completely FALK-designed and FALK-built for a long life of dependable, trouble-free service. *Precision-cut helical gears of highest efficiency* are employed for efficient, quiet operation.

Always available promptly from factory and distributor stocks, from *coast to coast*. For details, ask your Falk Representative or Distributor—or write for **Bulletin 7101.**

A FEW OF THE MANY APPLICATION FEATURES



VARIABLE SPEEDS through use of variable-pitch sheaves—automatic belt adjustment with tie-rod adjustment

OVERLOAD RELEASE that will slacken belts and cut off power if overload occurs

THE FALK CORPORATION, 3001 W. CANAL ST., MILWAUKEE 1, WIS.

Representatives and Distributors in Most Principal Cities

Manufacturers of

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

FALK

...a good name in industry

YOU GET

Close-to-home Service by Pump-wise Distributors

WHEN YOU SAY GASO

- Gaso distributors know pumping conditions and how to meet them.
- They carry stocks of pumps and parts.
- They are Gaso-trained and service-minded.
- They bring GASO experience, facilities and products to your doorstep.
- *We are as close to you as our nearest distributor.*

GASO PUMPS
for every oil industry need

GASO PUMP & BURNER MFG. CO.
TULSA, OKLAHOMA
Export Office: 149 BROADWAY, NEW YORK

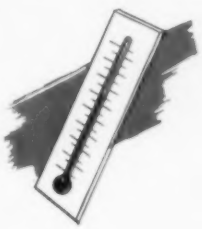
What's YOUR Roller Bearing Problem?

HYATT BUILDS AMERICA'S MOST COMPLETE LINE OF CYLINDRICAL ROLLER BEARINGS TO SOLVE IT BETTER!

HYATTS ARE DESIGNED:

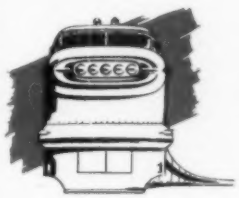
FOR SPEEDS UP TO 50,000 RPM.

From bearings for slow-moving construction equipment to supersonic jet engines, Hyatt builds roller bearings to meet almost any speed requirements.



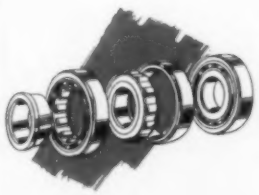
FOR TEMPERATURES FROM BELOW ZERO TO 450°F.

Conventional steels can be stabilized by heat treatment for operation up to 450°F. Beyond this we can provide special high-temperature steels for special needs.



FOR LOADS RANGING UP TO 103,000 POUNDS

From small bearings for lawn mowers to the huge heavy-duty types used in giant diesel locomotives, Hyatt builds bearings for every load requirement!



IN SIZES RANGING FROM ¾" OD TO 14" OD

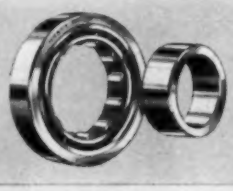
Hyatt offers a wide variety of bearing types and sizes. Each Hyatt Roller Bearing assures maximum life in each individual application.

Life, load, speed, temperature, shaft location—almost every roller bearing application problem you are likely to face has *already* been encountered by Hyatt engineers.

Armed with a complete line of bearings, they can usually come up with an answer to your particular design problem. In addition to competent design assistance, you can also depend upon the consistent high quality and uniformity of Hyatt Bearings.

HY-LOAD

High-capacity cylindrical roller bearings for heavy radial loads and light or intermittent thrust loads.

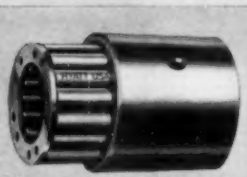


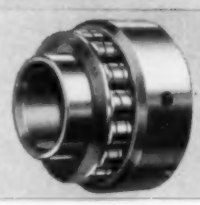
INDUSTRIAL INCH

Designed for slow-moving, heavily-loaded machinery where large-diameter shafts are usually employed.

TRUNNIONED ROLLER

For industrial trucks, textile machinery, gear pumps, conveyors, hoists and agricultural equipment.





WOUND ROLLER

A three-part separable bearing, which provides maximum resistance to shock, abrasion and fatigue.

These are a few of the reasons why experienced design engineers have learned to reach for a Hyatt catalog. If you need the technical assistance of a sales engineer, call or write Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey, Pittsburgh, Chicago, Detroit, Oakland, Calif.

AVAILABLE THROUGH UNITED MOTORS SERVICE DISTRIBUTORS EVERYWHERE

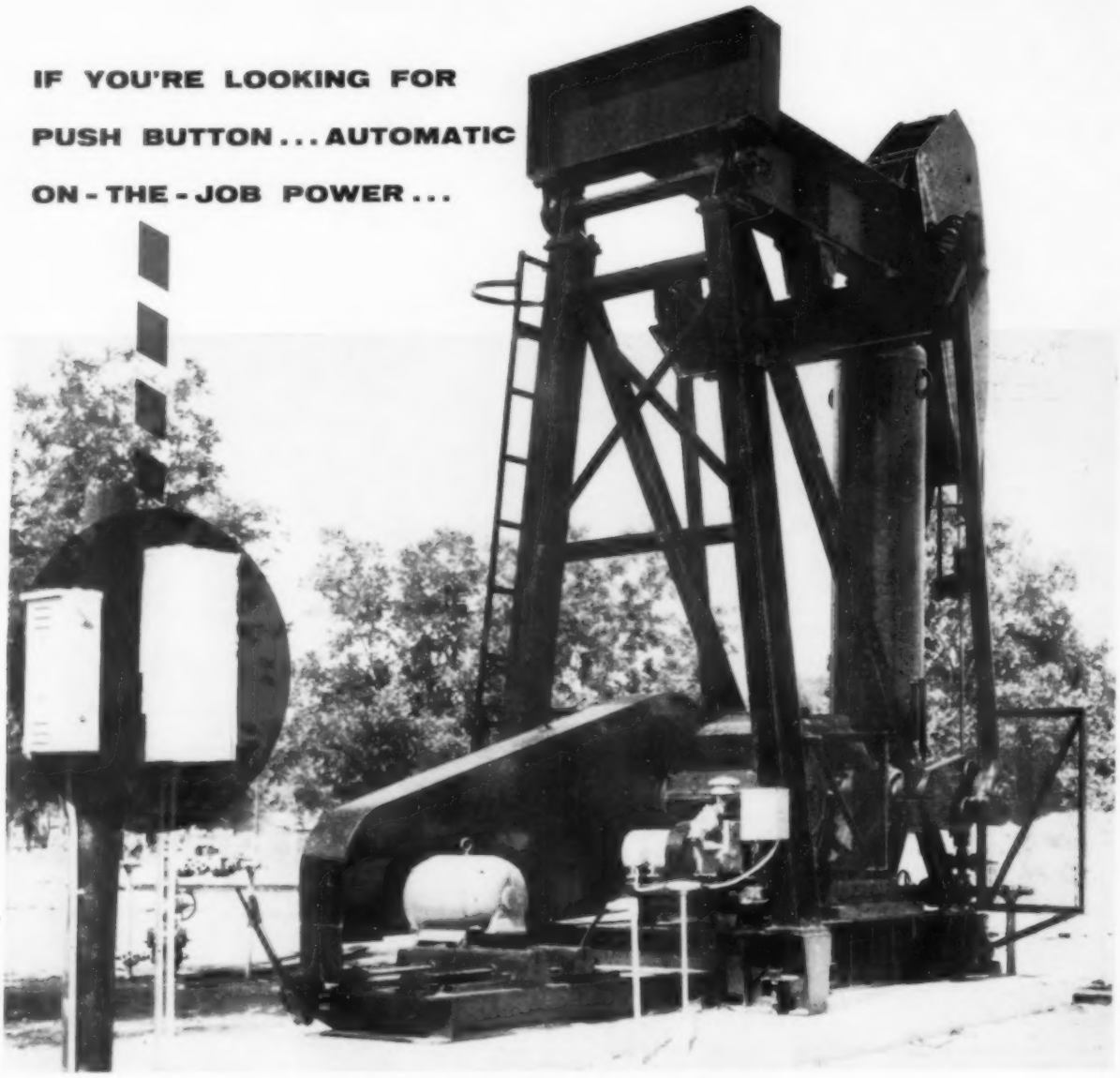
GM PARTS SALES

HYATT HY-ROLL BEARINGS FOR MODERN INDUSTRY

IF YOU'RE LOOKING FOR

PUSH BUTTON... AUTOMATIC

ON-THE-JOB POWER...



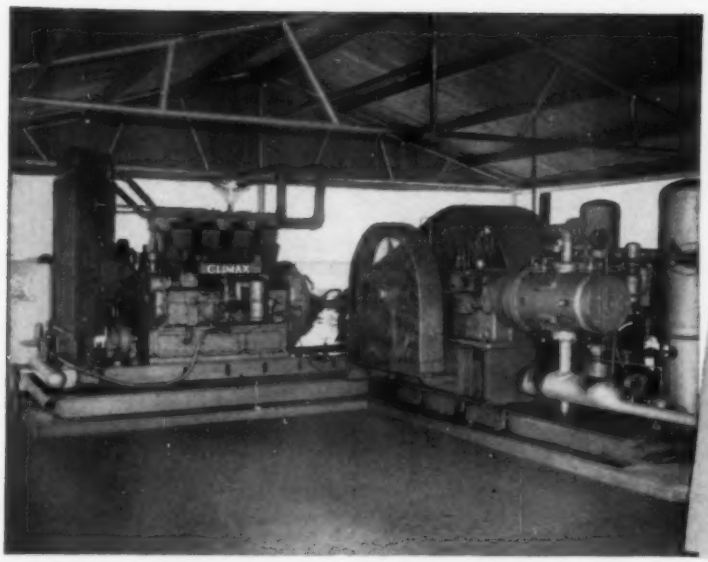
Be a bit shrewder . . . use ELECTRIC POWER

Automation is the key word in more efficient and progressive management today. And when you think of *automation* you must associate it immediately with UTILITY ELECTRIC POWER. Only UTILITY ELECTRIC POWER provides the complete, fully automatic features of automation in oil field production. The evidence is so impressive in favor of UTILITY ELECTRIC POWER that all companies – who consider themselves progressive – will want to know how they can benefit from this modern, efficient power. Call the sales engineer of your Utility Electric Service Company for complete facts.

I'm LCP – Low-Cost Power on the Job 24 Hours Daily

PETROLEUM ELECTRIC POWER ASSOCIATION

P. O. BOX 2771 DALLAS, TEXAS



One of two Climax V-85 installations at Tex-Penn's Plymouth Field near Corpus Christi, Texas. Engines drive gas compressors on a closed jet system.

Climax Engines are

FIELD RECOMMENDED

Mr. F. F. Dueser, Production Superintendent, Tex-Penn Oil Co., Corpus Christi, Texas, states that he is "well satisfied" with his Climax engines. Both V-85 Units operate on a 24-hour per day, 365 day yearly basis and minimum downtime has been encountered since installation. "In addition, my Climax engines give excellent performance, operate at low cost per horsepower and are dependable," comments Mr. Dueser, "and I strongly recommend them for any similar oil field applications."

CHECK THESE IMPORTANT FEATURES OF CLIMAX V AND K SERIES ENGINES

- *All models have renewable cylinder sleeves.*
- *All intake and exhaust valves are free-to-rotate type.*
- *All crankshafts are supported by bearings on each side of each crankthrow.*
- *All connecting rods are rifle drilled for pressure lubrication of piston pins.*
- *All cylinder heads have Climax high-turbulence type combustion chambers which produce maximum fuel economy.*
- *All models have the Climax consistent design that makes possible maximum interchangeability of wearing parts.*

Write today for your copy of bulletin SA-611, "Special Power Units for Gas Compressors."

CLIMAX ENGINE MANUFACTURING COMPANY

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FACTORY—CLINTON, IOWA • DISTRICT OFFICE—DALLAS, TEXAS

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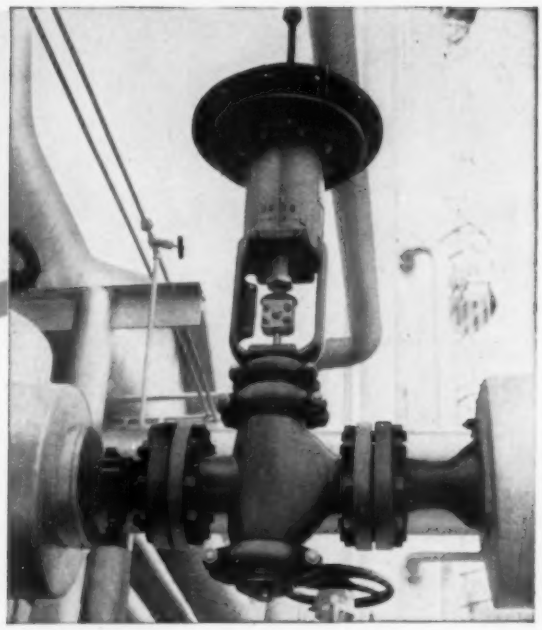
In Canada: THE CANADIAN FAIRBANKS-MORSE CO., LTD., Montreal, Quebec, and 16 Branches

ON STREAM...



BS&B's NEW *Super* 70 series

Entirely New Actuator Gives Accurate Linear Response!

- ✓ Choice of direct or reverse acting types in four sizes.
- ✓ Buna-N moulded diaphragm, reinforced with Nylon, gives uniform effective area through full valve travel.
- ✓ Cadmium plated pressed steel diaphragm cases give maximum strength and corrosion resistance with minimum weight.
- ✓ Bolted clamp ring, joining body and actuator, permits yoke to be oriented to any convenient position.

New Valve Body Gives Greater Stability Than Ever!

- ✓ Choice of single port, double port or split body.
- ✓ Streamlined contours provide more stable flow at all inner valve positions.
- ✓ Precision inner valves give more exacting flow characteristics.
- ✓ Patented float ring provides positive self-actuating seal.

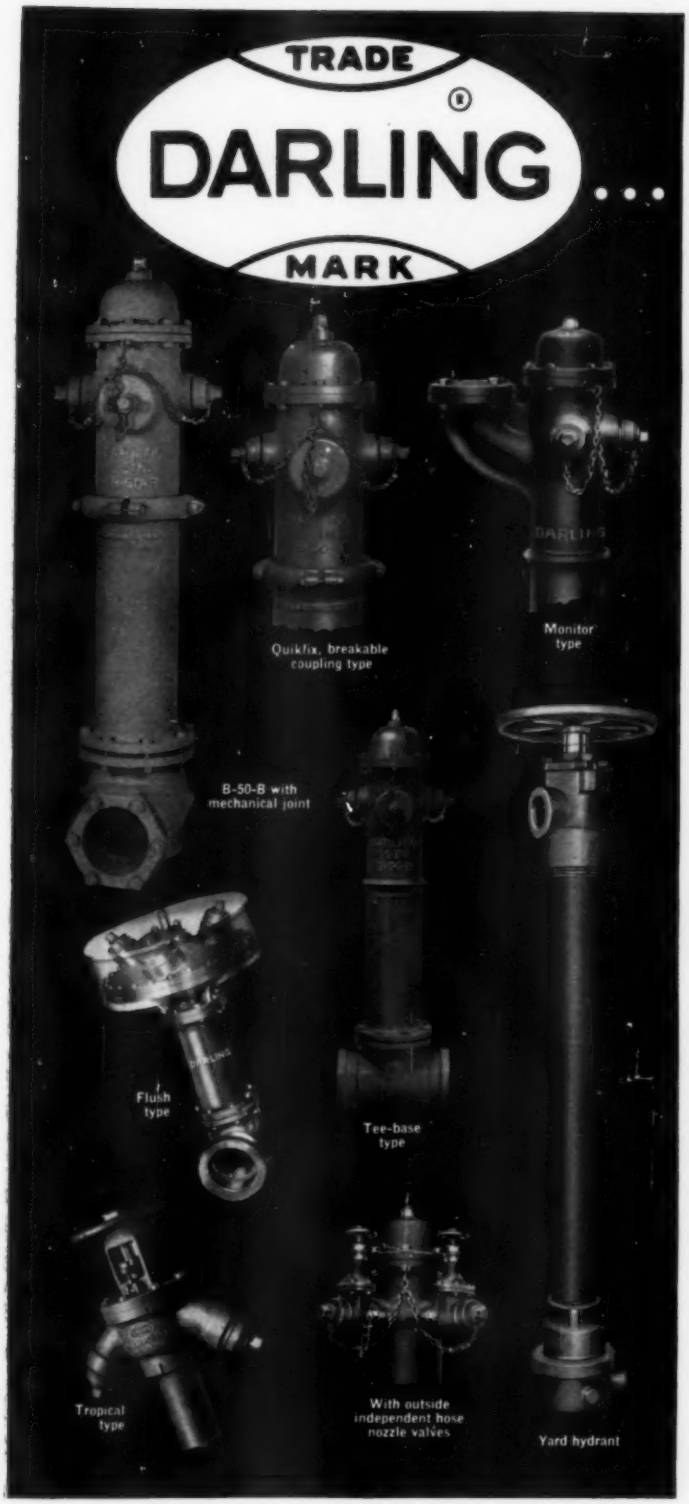
EFFICIENCY OVER 60 YEARS BS&B RELIABILITY
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

For more information on the all-new BS&B Super 70 Series Diaphragm Control Valves, ask your BS&B Sales Engineer—or write for Catalog 70-11.

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-A7

7500 East 12th Street Kansas City 26, Missouri



HYDRANTS FOR PLANT PROTECTION

Types and sizes for every requirement

YOU'LL be ahead on many counts when you specify modern Darling Fire Hydrants. Just for example . . .

Your system can include hydrant types exactly right for special or unusual service needs — breakable coupling types where traffic damage is common, concealed flush types for airport and pavement installation, Tee-base types to eliminate lateral connections where practicable. These and a few of the other types are shown here.

Equally important, Darling's unique B-50-B development (now available in all except the Tropical type) introduces *ball-bearing* operation combined with "O" ring seals. Result: a packless, dry-top hydrant. No packing gland maintenance. Operating threads and bearings *stay* lubricated and water can't reach them. Operation is far easier, far faster . . . and you avoid lots of maintenance time and trouble.

Send for complete information. Better still, ask to have a Darling engineer check your needs and tell you just what you stand to gain with Darling Hydrants.

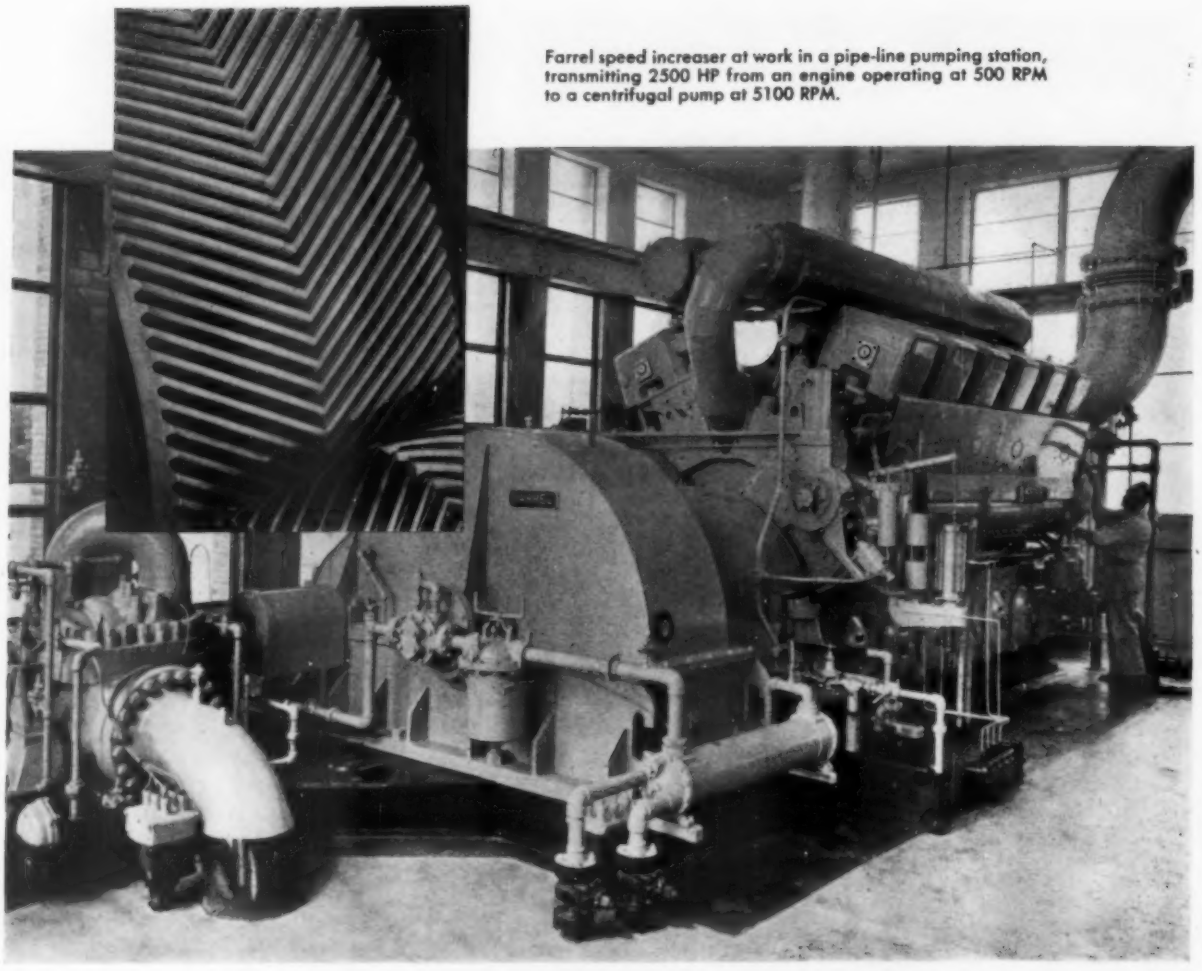
TRADE DARLING MARK

DARLING VALVE & MANUFACTURING CO.

Williamsport 1, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.

Farrel speed increaser at work in a pipe-line pumping station, transmitting 2500 HP from an engine operating at 500 RPM to a centrifugal pump at 5100 RPM.



HOW TO MAKE SURE

of service continuity in a speed increaser

Continuous, trouble-free operation is a first requirement in speed increasers for pipe-line service. This dependability has to be built into the unit. Every construction detail must be carefully engineered to provide ample reserves of strength and durability.

For example, the gears in a Farrel® speed increaser have a *backbone* formed where the helices meet. No center groove for tool clearance is required when double helical gear teeth are generated by the Farrel-Sykes method. The teeth are continuous and the full face width of the gear works at transmitting power. Result: Extra strength and load-carrying capacity in smaller space.

Oversize shafts guard against torsional deflection under peak torque variations. Shafts are mounted in husky, precision-finished bearings. Original alignment of moving parts is preserved by the rigid housing.

Proof of the dependability of Farrel speed increasers is on record. Since 1932, when they were first put into service, not a single unit has ever had to be replaced.

Remember this record when you are in the market for speed increasers. Send for details. Ask for a copy of bulletin 448-A.

FARREL-BIRMINGHAM COMPANY, INC.

ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.

Sales Offices: Ansonia, Buffalo, Boston, Akron, Ann Arbor (Mich.), Chicago, Minneapolis, Fayetteville (N. C.), Los Angeles, Salt Lake City

OIL FIELD REPRESENTATIVES

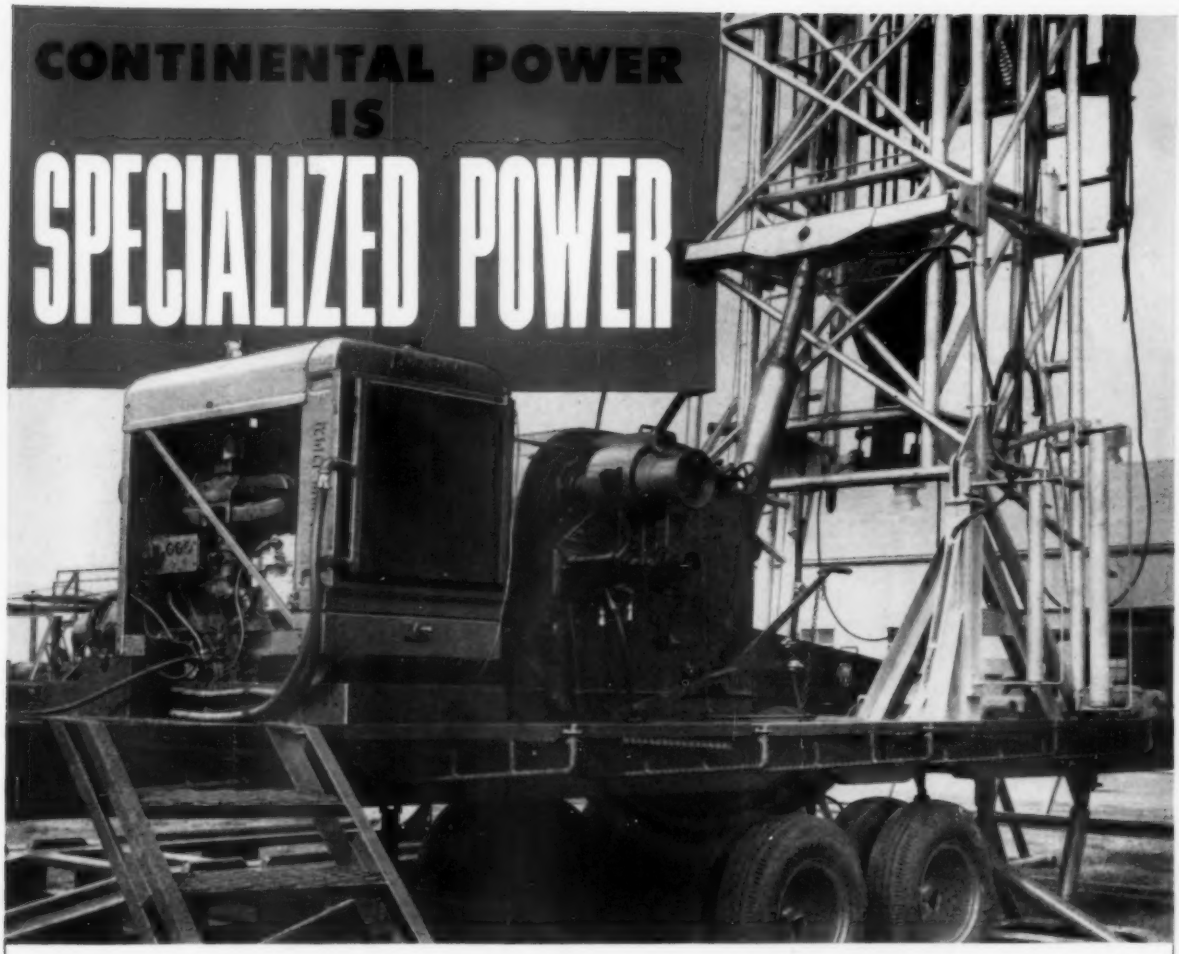
Hercules-Lupfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Okla.

V. W. Osborne, 860A M&M Bldg., Houston 2, Texas

Farrel-Birmingham ®

FB-1100

CONTINENTAL POWER IS SPECIALIZED POWER



No doubt about it, Continental Red Seal power owes a great share of its fine reputation to the fact that every model is truly specialized—engineered with the needs of a specific application in mind. It delivers extra satisfaction for the simple reason that it's built to do the particular job for which it is designed. . . . The installation shown above is a Spencer No. 5000 drilling rig with 93-ft. portable mast for drilling oil wells to 4,000 feet. Power is supplied by a Continental Red Seal model R602, fuel (LPG), with twin-disc torque converter. . . . You'll find one or more Red Seal models, in a broad horsepower range and at closely-spaced power levels, to match just about every oil field job, in drilling, producing, distribution, or processing —and they're available for operation on all standard fuels. See your oil field supply store or write for information.

•

RED SEAL ENGINES ARE BACKED BY PARTS AND SERVICE EVERYWHERE

CONTINENTAL MOTORS® Powerful as the Nation AMERICA'S STANDARD

Continental Motors Corporation
MUSKEGON, MICHIGAN

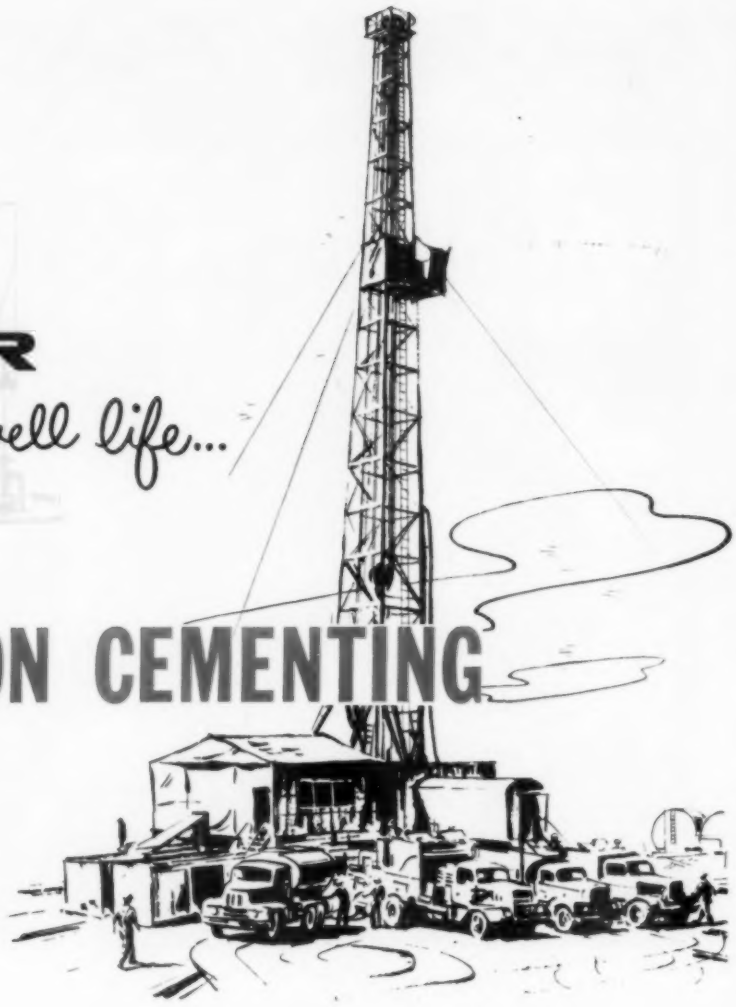
WORLD'S LEADING INDEPENDENT MANUFACTURER OF INTERNAL COMBUSTION ENGINES, CONTINENTAL MOTORS OPERATES PLANTS IN ATLANTA, DALLAS, DETROIT, MILWAUKEE, MUSKEGON, AND TOLEDO, AND IN ST. THOMAS, ONT., PRODUCING AIR-COOLED AND LIQUID-COOLED ENGINES FOR USE ON LAND, AT SEA AND IN THE AIR.

For

LONGER

well life...

HALLIBURTON CEMENTING



Casing a well is a major expense in drilling. Your casing job requires a good cementing job which is designed to:

- protect and conserve possible oil productive zones until they are ready to be tested or produced
- preclude migration of water, oil or gas from one formation to another
- protect casing from corrosive waters
- reduce danger of contamination of potable water
- control high or low pressure zones encountered

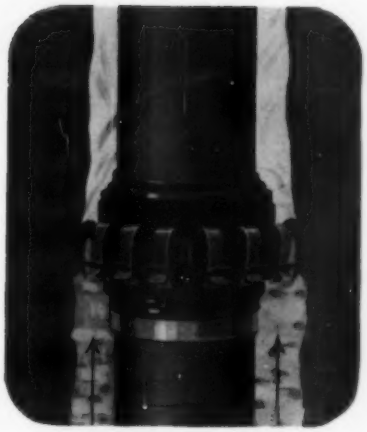
Moreover, a cementing job by Halliburton aids in providing a base for fracturing, squeeze cementing and future workover for the life of your well.

HALLIBURTON

OIL WELL CEMENTING COMPANY

DUNCAN, OKLAHOMA

HALLIBURTON CEMENTING AIDS HELP PROTECT CASING AND FORMATION



Halliburton Recipo Wall Cleaner

NEW – HALLIBURTON RECIPO WALL CLEANER

A new concept in the design of a reciprocating type cleaner. Removes filter cake from wall of bore hole more effectively.

Halliburton's new Recipo Wall Cleaner offers these advantages:

- Flexible rubber cleaning fingers minimize possible bore hole or filter cake damage, yet are sufficiently rugged to thoroughly clean wall.
- Wider fluid passage areas are provided between rubber cleaning fingers to reduce circulating pressures and bridging action of filter cake cuttings.
- Wider rubber cleaning fingers clean broader area of bore hole, aid in reducing channeling action of cement through drilling fluid during cement job.
- Cleaning fingers do not bend into permanent distortion.
- Hinged type design permits fast, easy latching on casing.

ADMIX SAFETY FLOAT COLLAR

Admix Safety Floating Equipment is used where Flocele, Howcogel and other additives are mixed with dry bulk cement to prevent loss of slurry to thirsty formations, or to obtain a better "fill-up."

In the event the Float Collar becomes plugged, specially engineered Safety Plugs pump out at a pre-determined pressure, minimizing the possibility of leaving the casing filled with additive mixed cement.

HALLIBURTON CEMENT BASKET

Used in primary cementing to retain cement and protect weak formations by reducing slurry loss or formation breakdown. Run on outside of casing or liner at point above weak or porous formations.

- After cement is pumped, basket helps support heavy cement columns until they take initial set.
- Made of high strength flexible steel staves, mounted on steel ring, and heavy duty water-proof canvas insert riveted to staves and ring.
- Flexible steel staves allow fluids to by-pass while running casing, circulating or cementing.
- Limit rings provide selective spacing of baskets between casing collars, are spot welded on pipe above and below each basket to permit movement of casing with basket open.

CEMENTING SERVICES

251 SERVICE CENTERS – JUST MINUTES AWAY FROM ANY RIG

THE HAMMOND DIALIFT

the only membrane type conservation tank

... with full-rated vapor and product capacity at all times

... with a membrane that cannot come in contact with product

... with vapor space that can be isolated for inspection and maintenance without taking tank out of service.

Principle of the Hammond Dialift

A—DIALIFT DIAPHRAGM rises and falls to accommodate expanding and contracting vapor.

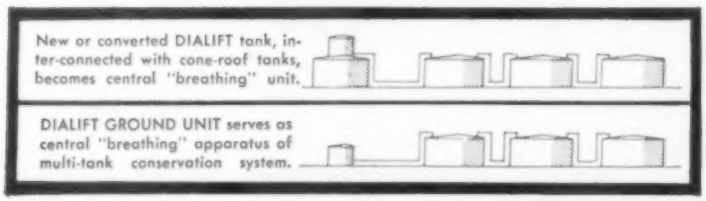
B—Vapor passes to and from tank and DIALIFT through simple elbow connection.

C—DIALIFT and tank have full-rated capacity.

D—Membrane can't come in contact with product.

E—DIALIFT can be isolated for maintenance and inspection, product tank stays in service.

The most efficient and economical vapor conservation system for new or old tanks.


New or converted DIALIFT tank, inter-connected with cone-roof tanks, becomes central "breathing" unit.
DIALIFT GROUND UNIT serves as central "breathing" apparatus of multi-tank conservation system.

THE HAMMOND DIALIFT consists of a gas-tight Vulcalock membrane attached to the inside periphery of a cylindrical metal housing to become a "breathing" apparatus to accommodate the expanding and contracting vapor as developed in product storage tanks. The DIALIFT can be used as a single conservation unit by being attached to the roof of a product storage tank or as a central "breathing" system by being manifolded to a number of product storage tanks. There are two forms of installation:—Ground type manifolded to a number of tanks to form a conservation system and integrated type whereby the DIALIFT is attached to the roof of a tank for vapor conservation for one or a number of tanks. The DIALIFT is completely isolated from the product storage tank. Vapor passes between the tank and DIALIFT through a vaporline connection. It is easy to convert old cone roof tanks to efficient vapor-saving DIALIFT installations by attaching a DIALIFT housing with membrane to the roof of the old tank and connecting the vaporline between the tank and DIALIFT.

THE HAMMOND DIALIFT ELIMINATES BREATHING LOSS AND REDUCES FILLING LOSS

Write for dialift catalog 55DL

HAMMOND IRON WORKS

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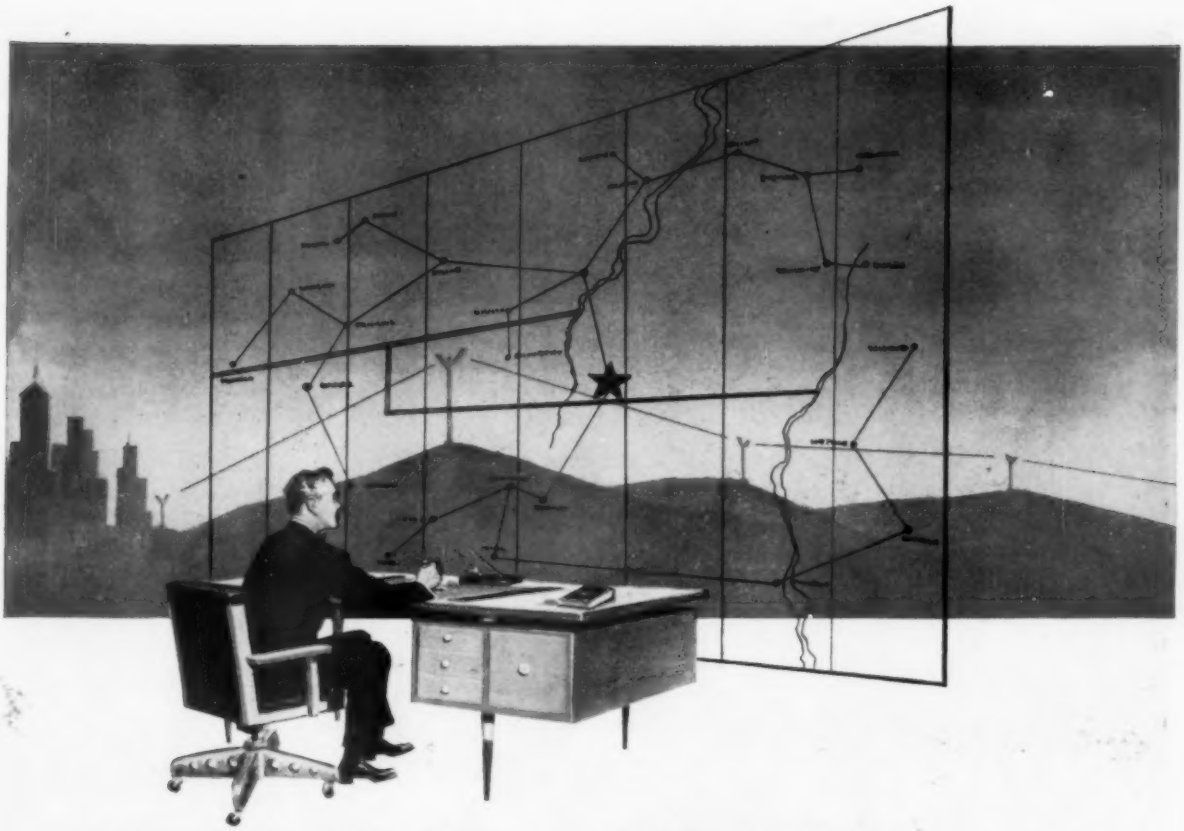


TEN MILES OR A THOUSAND . . .

Motorola Microwave puts complete operational control at your fingertips

Cross-country or cross-town—Motorola Microwave can give you centralized control in one *complete*, privately-owned communication system that spans city streets, rivers, and mountains with ease. Multiply your present communication facilities with this work-horse that provides multi-channel facilities for transmitting and receiving orders and instructions by voice, printed messages and control signals. It will speed a thousand tasks a day, working 'round the clock to give you better control, improved coordination and increased efficiency . . . all at a substantial savings in cost.

With Motorola Microwave serving all types of applications (many of them in your industry) you get the benefit of extensive experience. In installation after installation, operational records prove that Motorola Microwave performs better, lasts longer and costs less to maintain.

Learn how Motorola Microwave can give you the *complete* communication system for centralized control. Write, wire, or phone today.

VOICE

Private line and party line—manual and dial telephone circuits—VHF mobile and base station 2-way radio . . . *all* can be carried hundreds of miles, economically and privately, by Motorola Microwave.

PRINTED MESSAGES

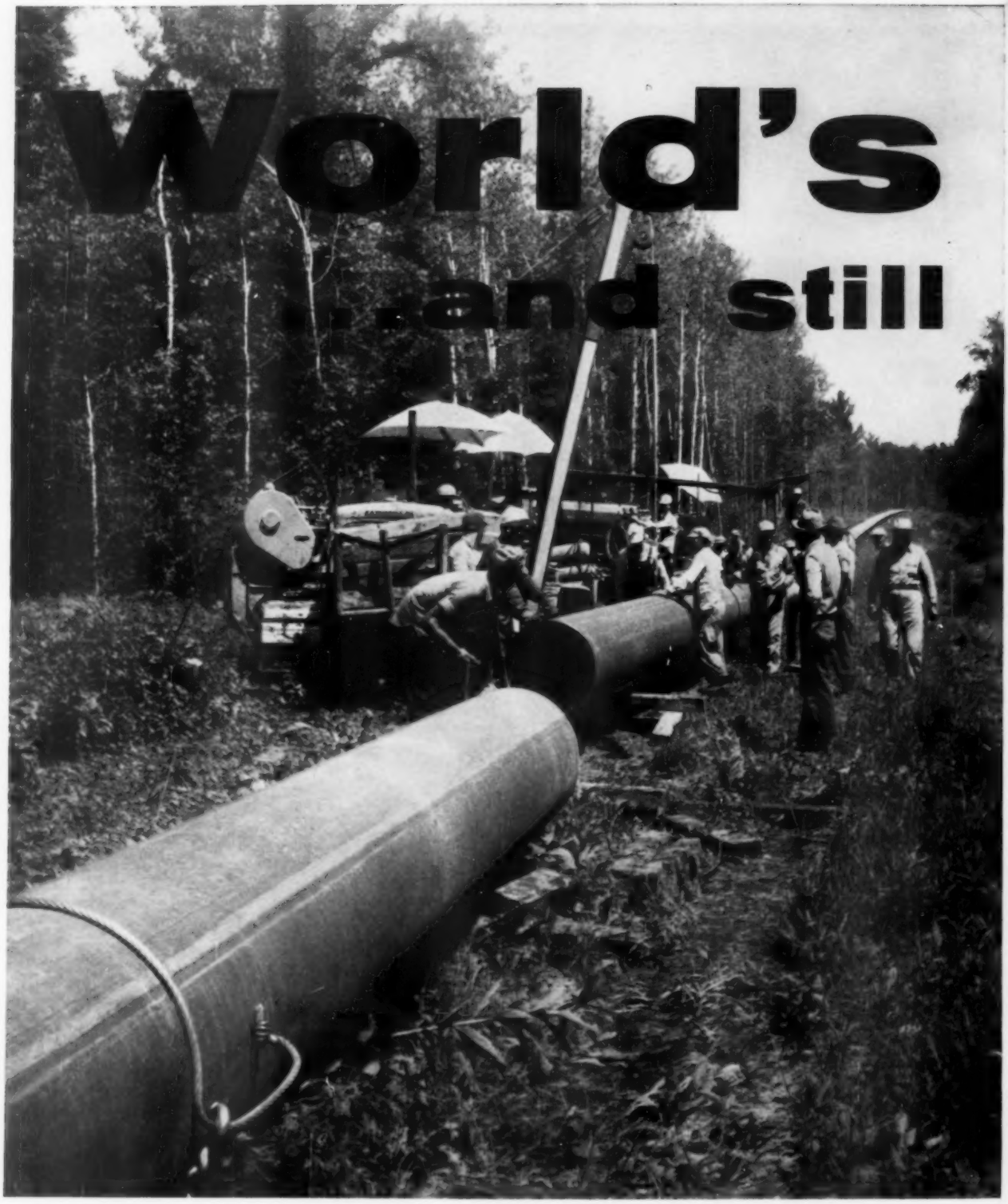
Read a message, a chart or facsimile a thousand miles away in seconds. Assemble necessary information the fast, efficient way. Teleprinting, telemetering, telegraph, facsimile are at your command with Microwave.

CONTROL SIGNALS

Read meters, turn valves, from *any* central location you want. With Motorola Microwave you can have supervisory control, remote control, and remote indication. Greater efficiency at less cost.

MOTOROLA MICROWAVE

Motorola Communications & Electronics, Inc., 1400 N. Cicero Ave., Chicago 51, Ill., A subsidiary of Motorola, Inc.



Interprovincial has extended their system from Superior to Sarnia and now from Sarnia to Port Credit, Ontario by the end of this year. It will then include over 3,000 miles of main line and loops. A. O. Smith's contribution to the system will be just above 50% of the total line laid.

longest growing!

Interprovincial Pipe Line Company has 1,774 miles of main line now in service . . . will extend this system another 156 miles during '57

THIS is the big crude oil carrier from Edmonton, Alberta, to refineries in the Prairie Provinces and Ontario in Canada . . . Minnesota, Wisconsin and Michigan in the U. S. Spanning 1,774 miles, it's already the world's longest line of this type and construction is now under way that will increase main line length to over 1,900 miles.

A. O. Smith is proud to have been a part of this great system since the original main line of 1129 miles was constructed in 1950. Over 70% of this original line to Superior, Wisconsin was supplied by A. O. Smith. Since that time from both Milwaukee and Houston mills, A. O. Smith has supplied most of the pipe for the looping work done on this original section in 1953, 1954, 1956 and 1957.

Map shows the complete system of main and looping lines as it will be when this year's construction is completed.

On the current project, A. O. Smith is supplying pipe for the looping lines being built near Glenavon and between Clearbrook and Superior.

For almost 30 years...

A. O. Smith line pipe has always been manufactured to a high standard of quality . . . precisely-controlled at every step of production. That's why A. O. Smith pipe, made and installed in 1928, is still in operation. That's why so much A. O. Smith pipe is in nearly every important high-pressure line.

Through research ... *a better way*

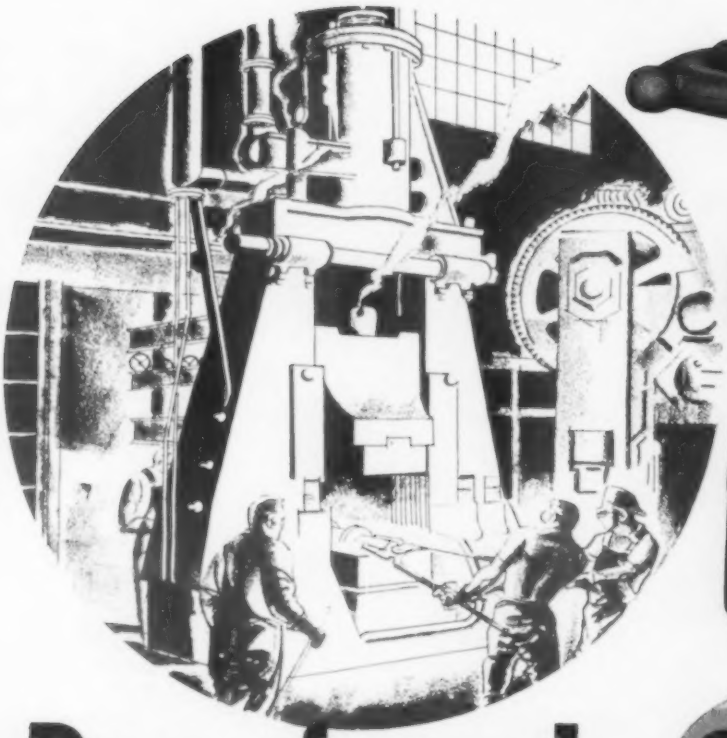
A.O.Smith
CORPORATION

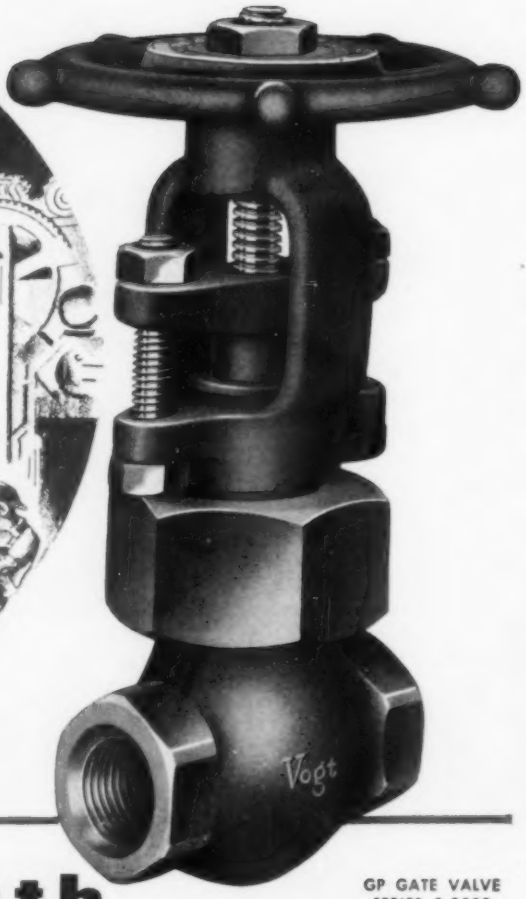
TUBULAR PRODUCTS DIVISION

Milwaukee 1, Wisconsin

Chicago 4 • Dallas 2 • Houston 2 • Los Angeles 17 • Midland 5, Texas • New Orleans 12 • New York 17 • San Francisco 4 • Seattle 1 • Tulsa 3 • Washington 6, D. C.

International Division: Milwaukee 1, Wisconsin





Drop forged for Strength and Safety

GP GATE VALVE
SERIES 5-9530

Drop forging techniques, resulting from more than a half century of pioneering and development by Vogt in the production of forged steel valves, impart matchless strength and safety to the new line of Vogt GP Valves. Made from killed, clean, fine grained open hearth steel billets, forging and treatment operations result in additional grain refinement and increased toughness.

GP Valves are setting new standards of performance in petroleum refineries, chemical plants, power plants, and related industries. Available in a complete range of sizes from ¼" to 2" and rated 800 pounds at 850°F. and 2000 pounds at 100°F.

Advt. No. 4 in a series describing the features of Vogt GP Valves.

Write For Your FREE COPY of Supplement No. 1 to Catalog F-9. Address Dept. 24A-FO

HENRY VOGT MACHINE CO.
P. O. Box 1918—Louisville 1, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati, San Francisco

Vogt

GENERAL PURPOSE GP

Vogt FOR BETTER VALVES

DROP FORGED STEEL

VALVES

Refinery men depend on Davison for...

M-S® CRACKING CATALYSTS
Silica-Alumina (13% and 25%)
Silica-Magnesia (experimental)

REFORMING CATALYSTS
Catforming Catalyst—Silica-Alumina-Platinum
Powerforming Catalyst—Alumina-Platinum

DEHYDROGENATION CATALYST
Chromia-Alumina

POLYOLEFIN CATALYST
Chromia-Silica-Alumina

DEHYDRATING AGENT
Silica Gel

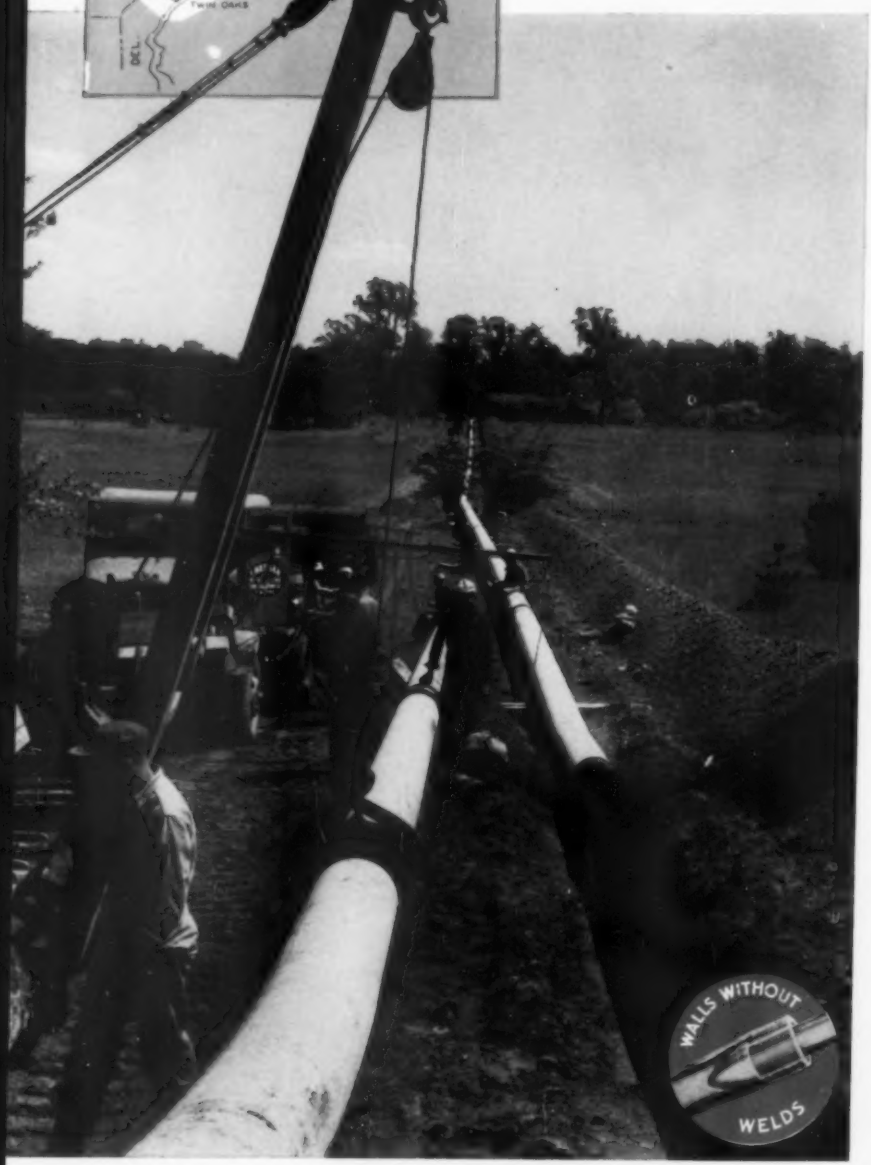
ANTIOXIDANTS
Dav-Ad 101 (alkylated phenol)
Dav-Ad 102 (alkylated phenol in toluene)

Complete laboratory facilities and technical assistance

DAVISON CHEMICAL COMPANY
Division of W. R. Grace & Co.
101 North Charles Street, Baltimore 3, Maryland

SALES OFFICES: Chicago, Ill.; Houston, Tex.; New York, N. Y.; Baltimore, Md.; San Francisco, Calif.; Tulsa, Okla.
In Canada: Davison Chemical Company Ltd., Toronto.

Sun Pipe Line Company's new 110-mile line of NATIONAL SEAMLESS doubles delivery capacity to vital Newark-New York area.



10,951 tons of 14″ National Seamless Pipe — varying in wall thickness from ¼″ to ½″ —now enables Sun Pipe Line Company to double its delivery to its Newark plant. The new pipeline also saves time, because it largely eliminates the need for water transportation from Twin Oaks, Pa., into crowded New York Harbor.

Requiring only one pump station, at Twin Oaks, better than 83,000 barrels of gasoline or 65,000 barrels of fuel oil can be handled every day. The new 14″ pipeline replaces Sun Pipe Line Company's old line . . . also constructed of National Tube pipe. It crosses three major rivers, the Schuylkill, Delaware and Raritan. These underwater portions of the line utilize the ½″ wall sections, where extra stress and strain are exerted. But withstanding extra-rough conditions is "old hat" to National Seamless Pipe . . . its reputation for accomplishing difficult tasks is well established.

National Seamless Line Pipe combines the characteristics of high strength, extreme flexibility, and uniformity, with superior welding properties, to assure the user of many years of satisfactory service.

NATIONAL TUBE DIVISION
UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

In Pipelines Too . . . Seamless Does It Better

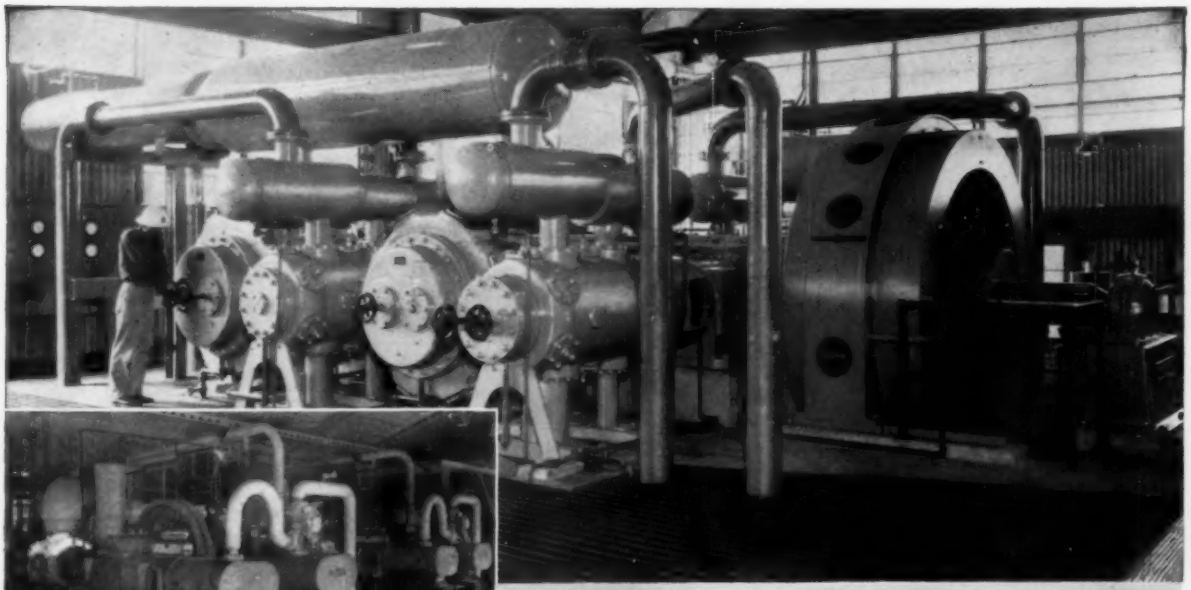
NATIONAL SEAMLESS PIPE AND TUBES

USS

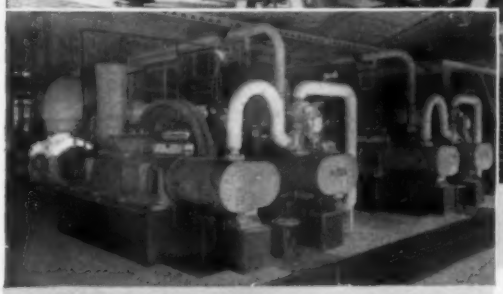
UNITED STATES STEEL

what assures a

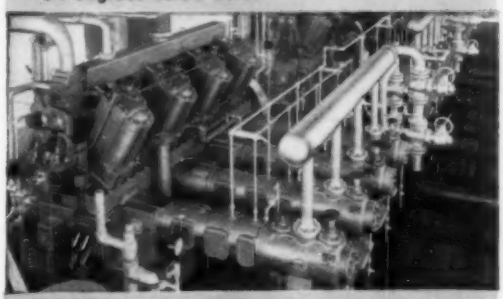
GOOD COMPRESSOR for PROCESS WORK?



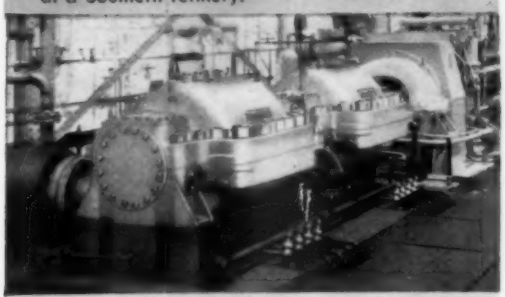
ELECTRIC-DRIVEN horizontal 4000-hp HHE compressor on multiple-gas service, compressing air to 645 psi, nitrogen to 330 psi and natural gas to 440 psi simultaneously in an ammonia plant.



STEAM-DRIVEN compressors with non-lubricated cylinders handling hydrogen chloride gas at 54 degrees below zero.



GAS-ENGINE compressors with non-lubricated compressor cylinders on hydrogen recycling duty at a Southern refinery.



CENTRIFUGAL compressors on ethylene refrigeration; these are tandem units driven by steam turbine.

In process jobs, any interruption of the cycle often means large loss of production, expensive repairs, and introduction of hazardous conditions. In manufacturing compressors for these jobs, there is one ingredient most vital.

That ingredient is knowledge. The compressor manufacturer must know how to predict conditions in the process which might force a shutdown, and must know how to meet those conditions with a compressor which will minimize the possibility of a shutdown.

Such knowledge is obtained only through years of actual experience in designing, building and applying compressors for all sorts of processes, for handling all kinds of gases, and for any range of pressures.

Ingersoll-Rand has more of that kind of experience than any other compressor builder. For information on process compressors for pressures up to 35,000 psi, contact your I-R representative or write direct. Ask for your copy of Form 3132A.

Ingersoll-Rand

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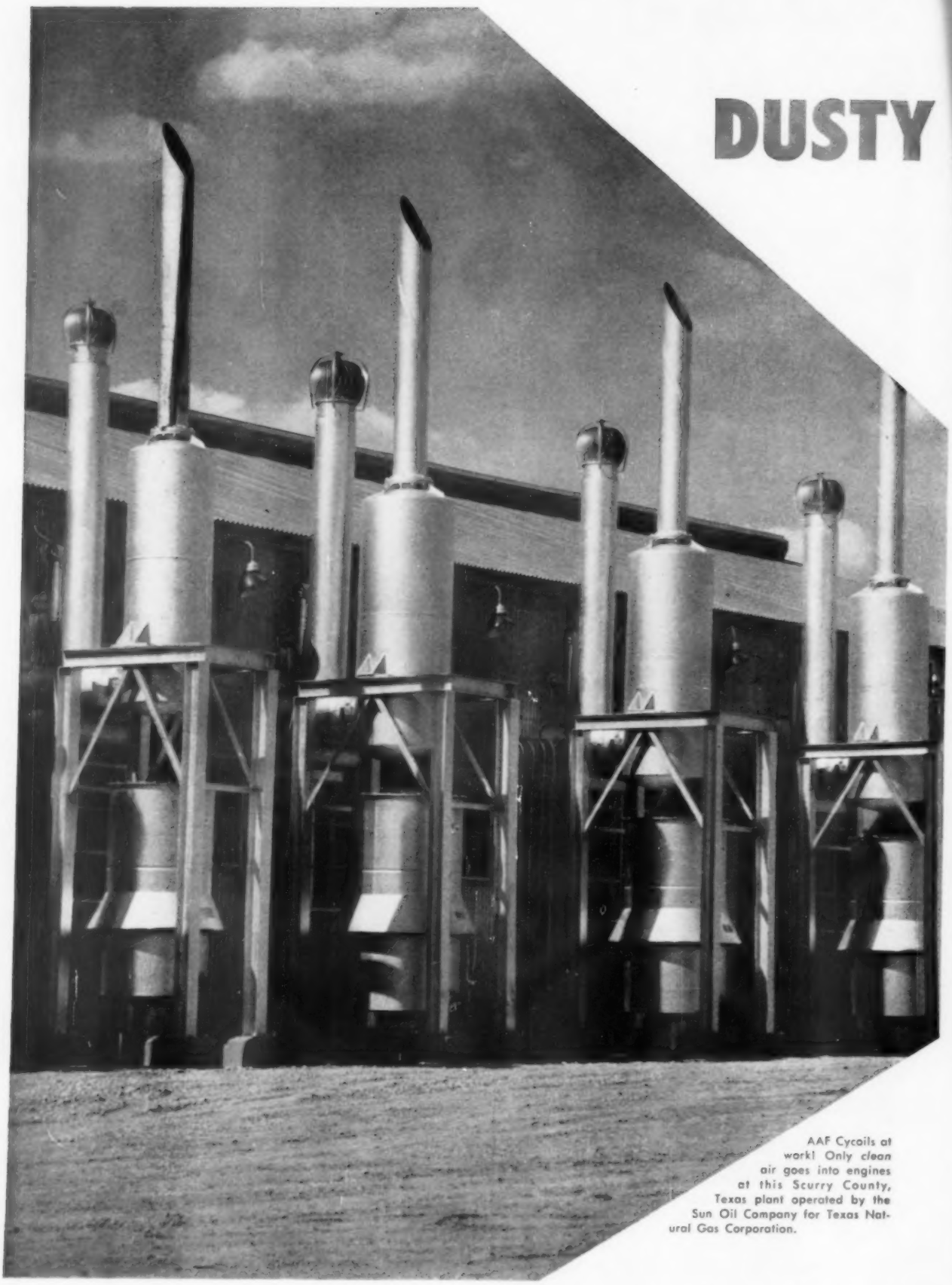
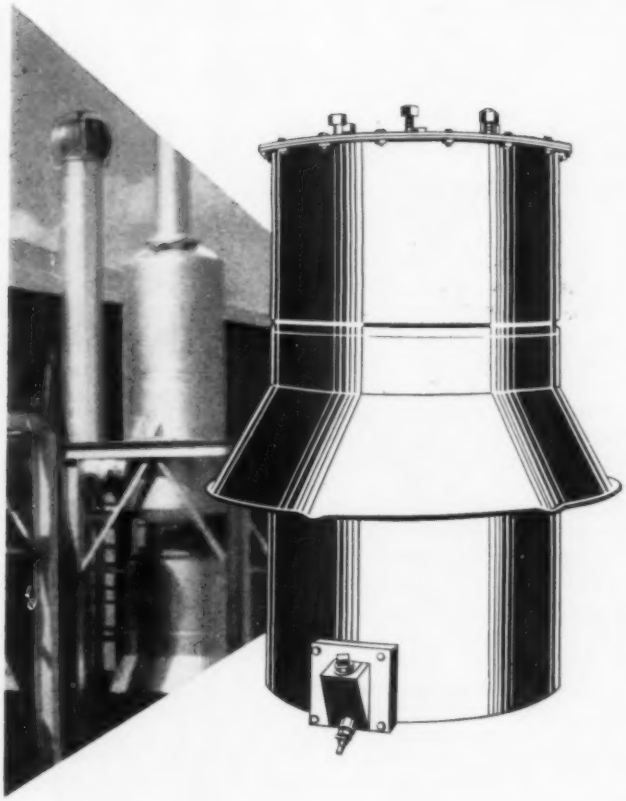
COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS



AAF Cycoils at work! Only *clean* air goes into engines at this Scurry County, Texas plant operated by the Sun Oil Company for Texas Natural Gas Corporation.

AIR BECOMES DUST-FREE—
4-WAY CLEANED BY CYCOILS!

AAF Cycoils protect engines—keep dust OUT—for Texas Natural Gas Corporation



Keeping dust and dirt out of engines is an important job—because only the best protection is enough. That's why you see six AAF Type W Cycoils at the Sacroc Water Flood plant of the Texas Natural Gas Corporation, in Scurry County, Texas.

These AAF Cycoil oil bath air filters give maximum protection because they provide 4-way cleaning—impingement, scrubbing, cyclonic action and filtering. Result: Cycoils deliver air that's virtually 100% *dust-free.* Actually, more than 90% of the fine dust content of air is trapped in oil and removed by centrifugal action—*before it even reaches the filter pads.* No wonder Cycoils save trouble, save money!

Find out more about 4-way cleaning and the other Cycoil advantages—uniform air delivery, constant efficiency, low operating resistance and minimum maintenance. Write today for full information. Just ask for Bulletin 130.

AAF herman nelson

American Air Filter
COMPANY, INC.
444 Central Avenue, Louisville 8, Kentucky
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Type CMS Multi-Duty Filters

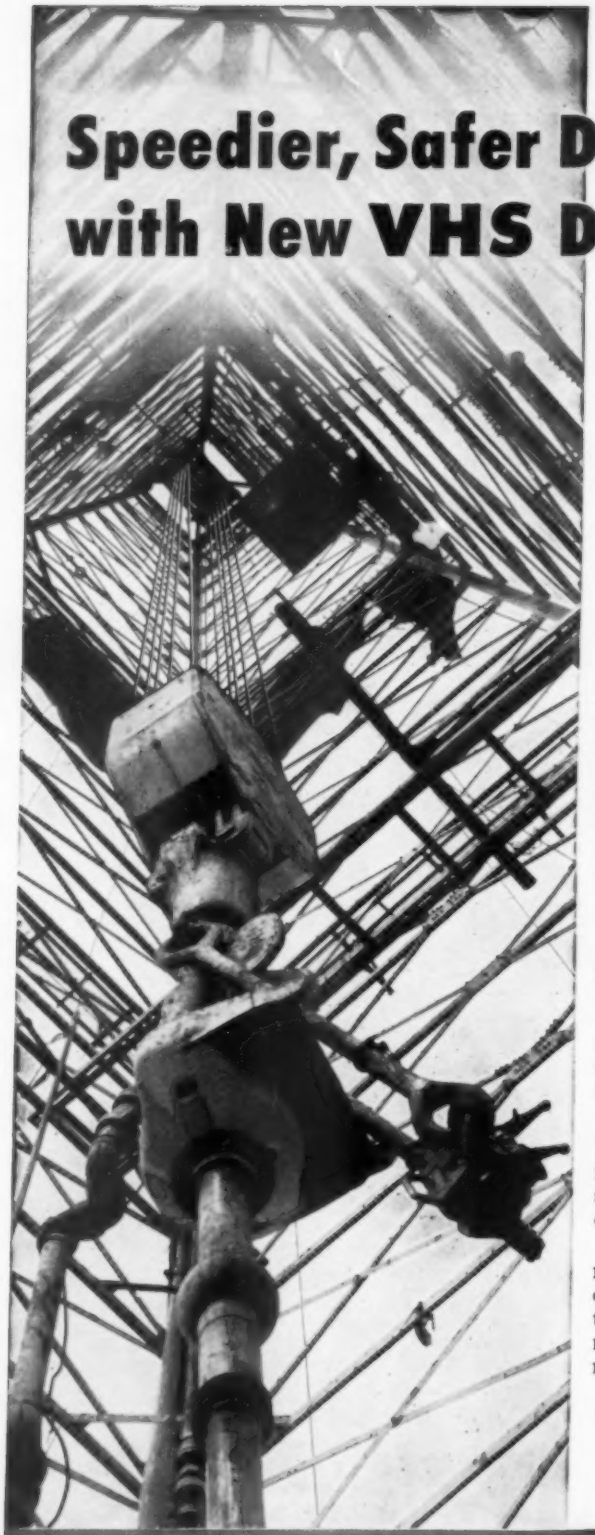
Type G Pipeline Air Filters

BETTER AIR IS OUR BUSINESS

Type OCH Intake Air Filters

Cycoil Oil Bath Air Filters

Speedier, Safer Drilling— with New VHS Drilling Lines



• More and more operators are getting faster, safer drilling with rotary drilling lines of new LAY-SET VHS. For new VHS is at least 15% stronger than Improved Plow Steel—the strongest grade available before VHS.

DRILL DEEPER

This extra strength means you can drill deeper before increasing the number of parts of line. You can make round trips faster. And VHS's extra strength eliminates in many cases any necessity for buying new blocks or regrooving sheaves to use larger diameter lines for higher safety factor.

HIGHER SAFETY FACTOR

The safety factor for 10 lines of new LAY-SET VHS is equal to that for 12 lines of IPS. Or, with 10 lines of VHS the safety factor is about 14.9, or 15%, higher than with 10 lines of IPS.

TOUGHER, TOO

A new VHS is tougher. It has greater resistance to abrasion and higher resistance to peening—both important factors in maintaining shape and diameter. Following regular, adaptable cut-off practices should result in ton-mile advantages.

WINCH LINES, TOO

Now new LAY-SET VHS is available in winch lines—where its extra strength and toughness pay big dividends.

Call your Hazard distributor for rotary drilling lines or winch lines of new LAY-SET VHS. Just tell him the size and diameter you want—no complicated specifications are necessary.

for further information write to the nearest Hazard office for Brochure DH-522

LAY-SET VHS

15% Stronger • Tougher •

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American Chain & Cable Company, Inc.

630 McFarland St., Houston 1, Texas | 4555 E. 46th Ave., Denver 16, Colorado | 2216 S. Garfield Ave., Los Angeles 22, Calif. | 400 W. Madison St., Chicago 6, Ill.

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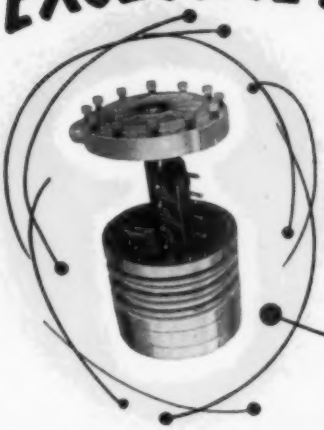
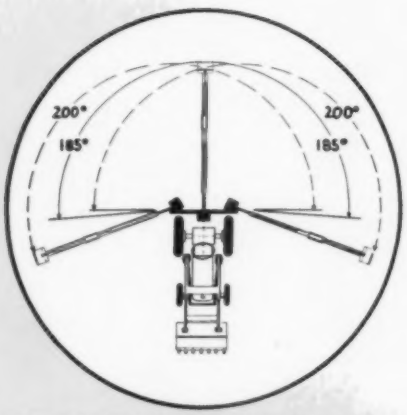
EXCLUSIVE!



NEW HYDRAULIC ROTARY BOOM SWING CYLINDER

DISCOVER DAVIS ...AND WHY IT WILL DO WHAT NO OTHER BACK-HOE CAN DO!

FLUSH DIGGING... with a 200° continuous operating arc... that's what the new Davis Model 210 does that no other machine can do. It will dig flush alongside buildings, fences, and other installations where you normally have to dig by hand! The exclusive hydraulic rotary boom swing cylinder and interchangeable mounting points on the frame are the key to its profit-making operation. The simple, compact cylinder with only one moving part replaces conventional swing rams, cables, and the inherent limitations as employed by all other back-hoes. The entire mast and boom assembly can be moved from center to either side for flush digging. It has smooth starts...cushioned stops, and because hydraulic pressure is constant, it permits a steady, controlled swing all the way around. This, plus all the other features that have made Davis America's largest selling back-hoe – right-angle operation, rotary seat, vertical stabilizer, 13′ depth, and ***7,000 pounds of breakaway*** mean more jobs...more profit...less time on each job. Get complete information on both the new 210 and the popular 185 Davis Back-hoes today. Available for most popular tractors and 1-ton or larger flat-bed trucks.



PROVIDES 200° CONTINUOUS OPERATING ARC

This diagram illustrates the degrees of continuous operating arc from each of the three mounting locations – 200° when side mounted, or 185° center mounted. Has no pins to change or cable to break.

Davis Back-hoes and Loaders are sold and serviced everywhere in the U.S.A. and Canada by better dealers!

FOR THE NAME OF YOUR NEAREST DEALER CALL WESTERN UNION BY NUMBER, AND ASK FOR OPERATOR 25 ... *or write direct*

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WHOOSH!
NO MORE
OIL FIRES!
Point horn, pull trigger, fire's out! That's all it takes to knock out deadly oil, gasoline, flammable liquid fires with instant-action Kidde dry chemical portable extinguishers! So easy to use, even inexperienced operators get perfect fire-fighting results. Kidde's patented diffuser horn spreads dry chemical powder over wider area for greater fire-killing power. Trigger-finger grip means faster action, feels more natural in the hand. Pick the Kidde dry chemical portable to fit your needs: 5, 10 lb. pressurized (recharged at any commercial air pump), 20, 30 lb. cartridge-operated. For more information, write today for Kidde's P-8 catalog and name of nearest distributor.

Kidde

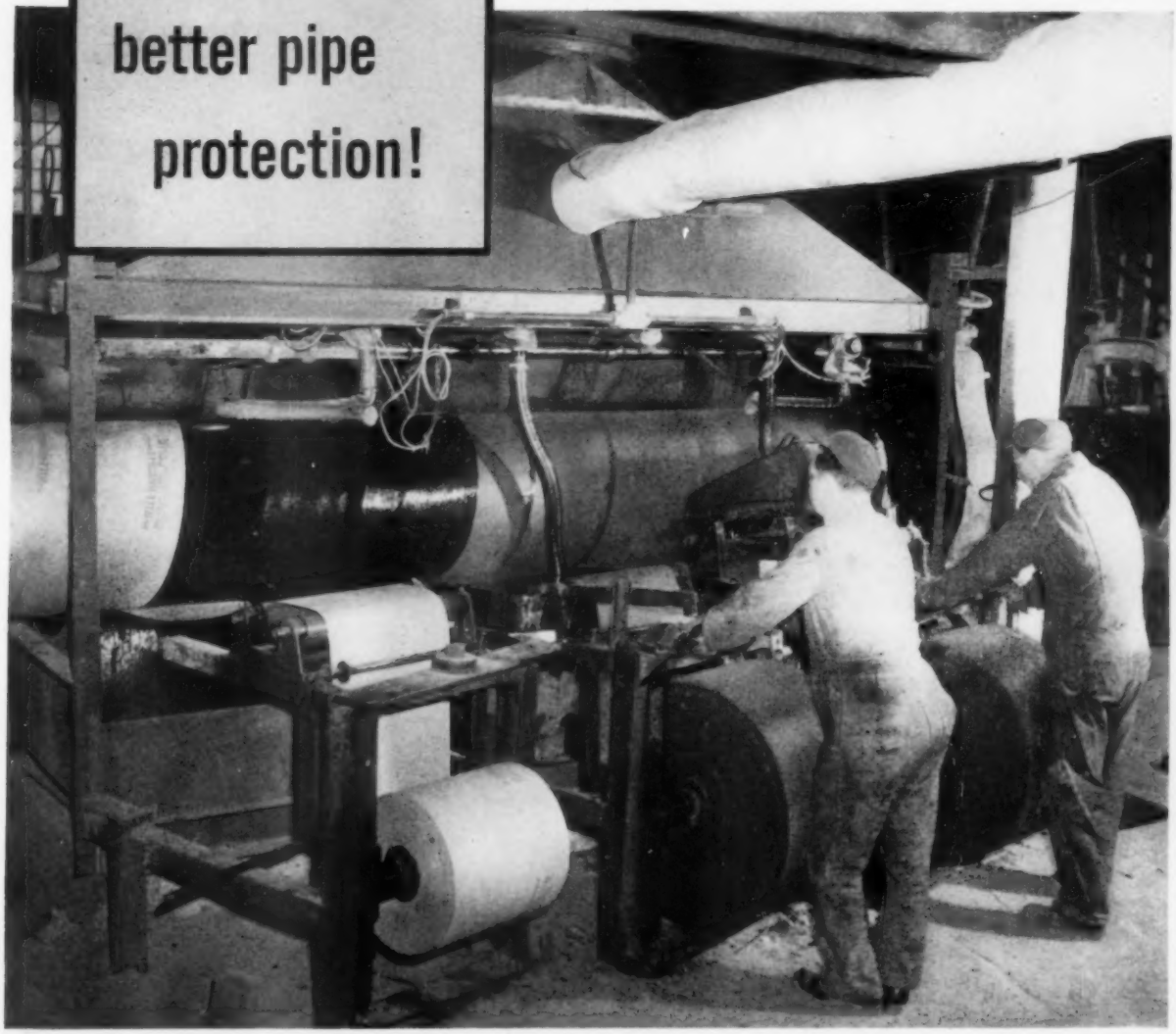
Walter Kidde & Company, Inc., 754 Main St., Belleville, 9 N. J.

Walter Kidde & Company of Canada Ltd., Montreal—Toronto

Here's where the tension mounts...for better pipe protection!

This remarkable machine is one big reason Hill, Hubbell leads in pipe protection. It is synchronized to 1) convey the pipe spirally at uniform speed, 2) apply to it the correct number and thickness of coatings, 3) adjust the overlap of various wrappings and, 4) actually adjust the tension on the wrappings so that the pipe is permanently protected!

This is another first by Hill, Hubbell, another reason to specify Hill, Hubbell wrapped pipe.



Specify Hill-Hubbell wrapped pipe on your next job

HILL·HUBBELL & COMPANY

DIVISION OF GENERAL PAINT CORP. • 3091 MAYFIELD ROAD, CLEVELAND 18, OHIO

FACTORY APPLICATORS OF COATINGS AND WRAPPINGS

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MODERN HOUSING FOR OPERATING PERSONNEL

HIGH PRESSURE PUMPS ON ALL RIGS

USE OF MAXIMUM DRILL COLLAR WEIGHT

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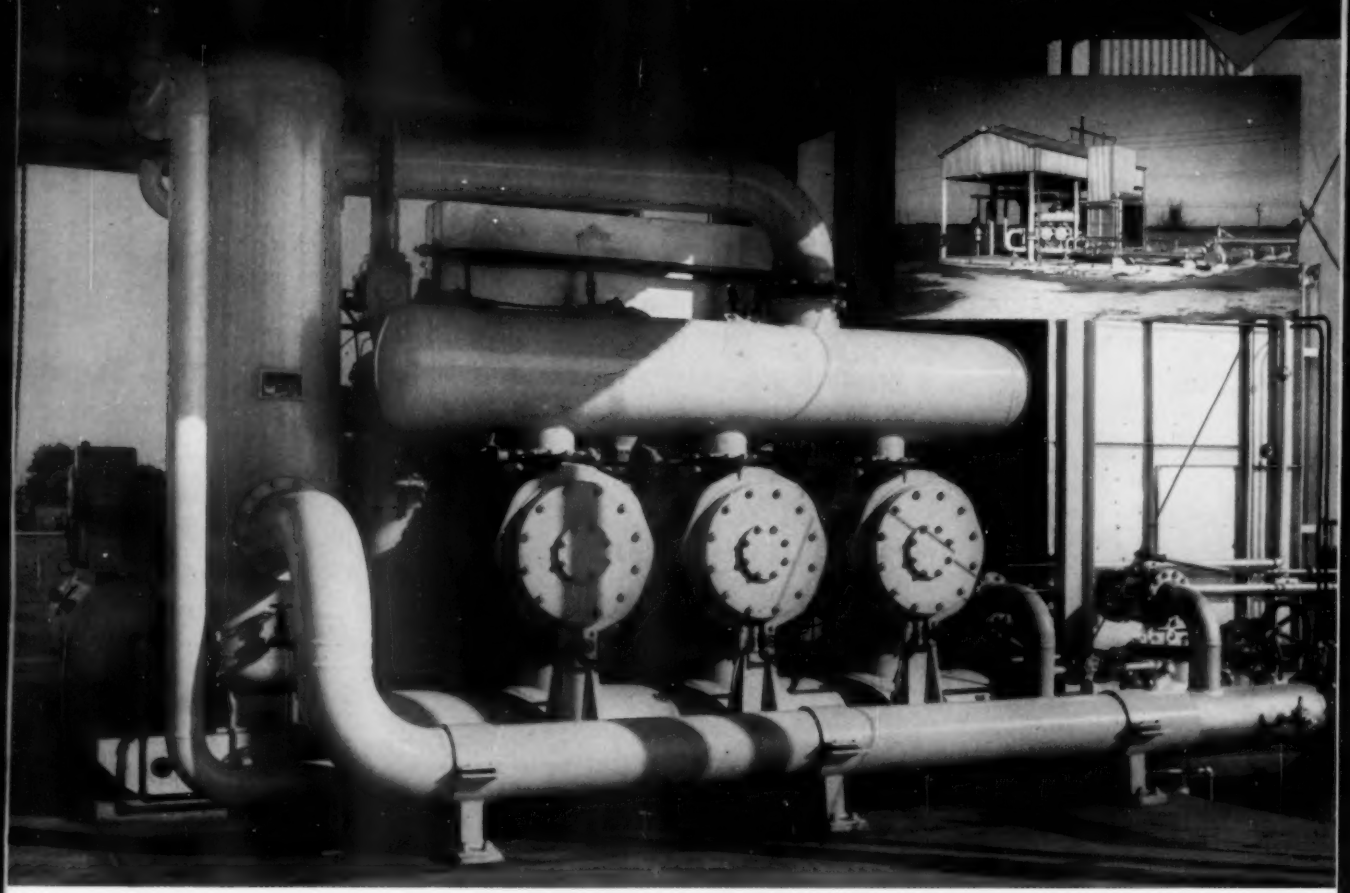
PENROD LAND AND SEA DRILLING COMPANY

BEAIRD-INGERSOLL-RAND Packaged Compressor Plant



UNITED GAS PIPELINE COMPANY'S Monroe Field Station No. 1 equipped with a Beaird-Ingersoll-Rand 6SVG 330 h. p. packaged compressor complete with all necessary controls for unattended operation. Other sizes from 120 to 660 h. p.

Unattended Operation-

HIGH VOLUME BOOSTER STATION

BEAIRD
another AMF product
PACKAGED COMPRESSOR PLANTS

LOWEST COST PER HORSEPOWER INSTALLED

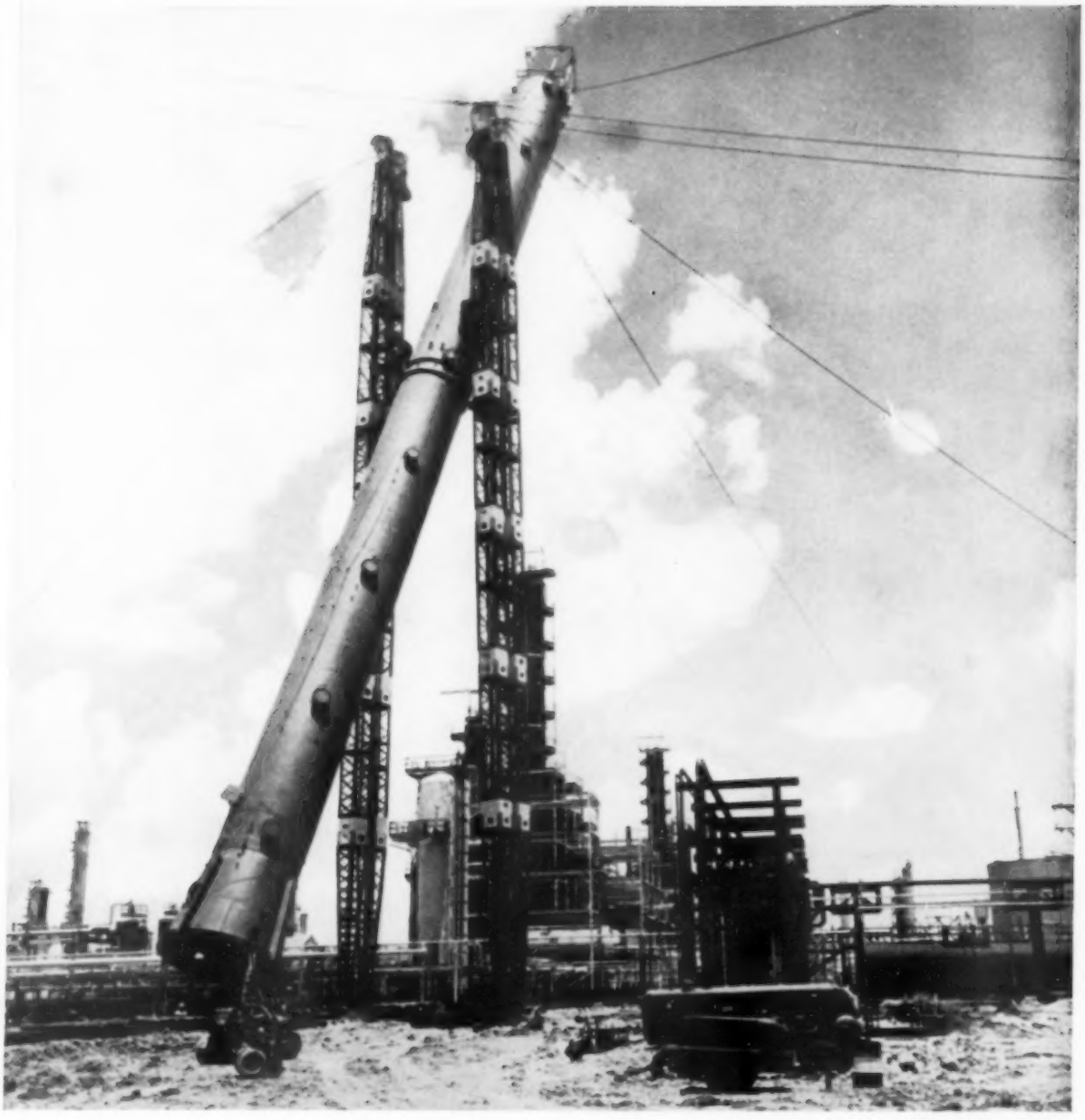
UNITED GAS PIPELINE COMPANY has installed this Compressor Station near Sterlington, Louisiana. Equipped with a Beaird-Ingersoll-Rand 6SVG 330 h.p. packaged compressor, the station is an integral part of United's Monroe Field facilities. Gas from declining wells in the field are boosted from 10 psig to main line pressure of 25 psig. Ten million cubic feet per day are handled by this single Beaird unit.

Designed for unattended operation, the compressor is equipped with regulators that enable the driving engine to throttle from half to full speed to maintain constant discharge pressure. Should operating conditions become less stable, compressor valve unloaders can be installed which will provide completely automatic operating control. The compressor will then unload its cylinders in steps, maintaining precision discharge pressure to the main line. When the condition causing the pressure build-up is eliminated, the unit would automatically close the unloading valves and pick up the required load.

Let us show you how a Beaird-Ingersoll-Rand packaged compressor plant can be designed to meet your special requirements.

THE J. B. BEAIRD COMPANY, INC.
Shreveport, Louisiana
A subsidiary of American Machine & Foundry Company

SHREVEPORT, LOUISIANA • *Sales Offices: Dallas, Houston, Corpus Christi and Midland, Texas • New Orleans, Louisiana • Tulsa, Oklahoma • Denver, Colorado Los Angeles, California • Caracas, Venezuela, and Cie. Ingersoll-Rand, Paris, France.*



"Over the years, Jersey's expenditures for capital equipment, and costs relating to the search for and development of new oil reserves, have been very large. For the current year they will amount to $3 for each $2 of last year's profit."

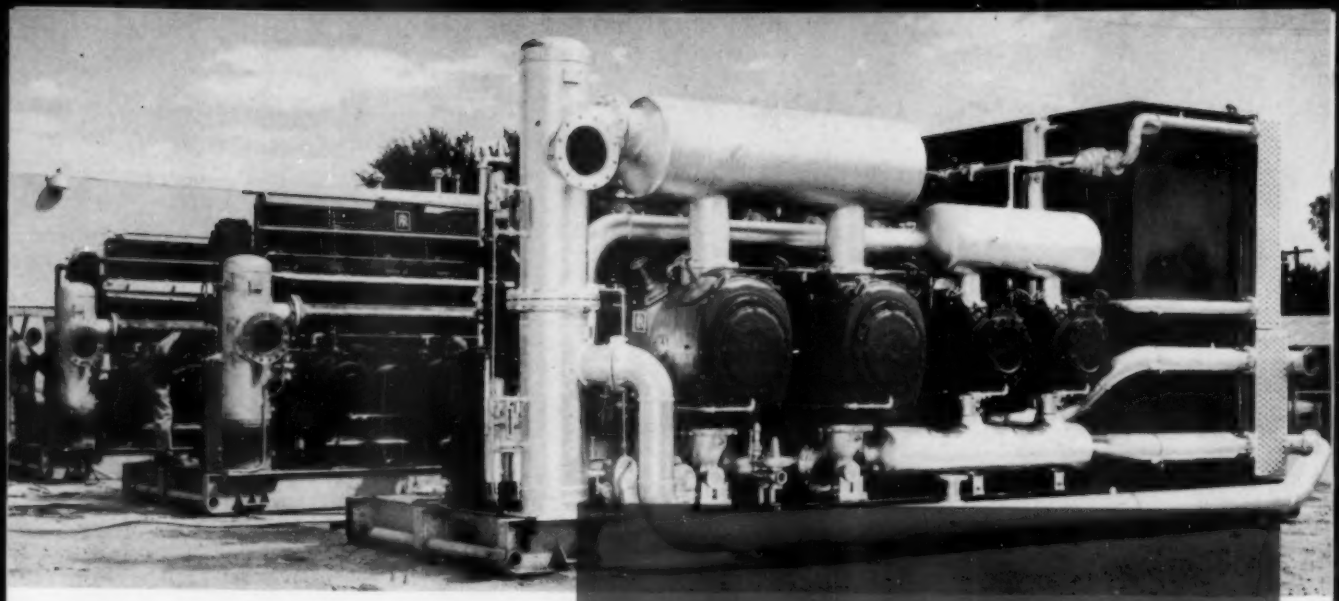
M. J. Rathbone, President, Standard Oil Company (New Jersey)

Esso 75 YEARS

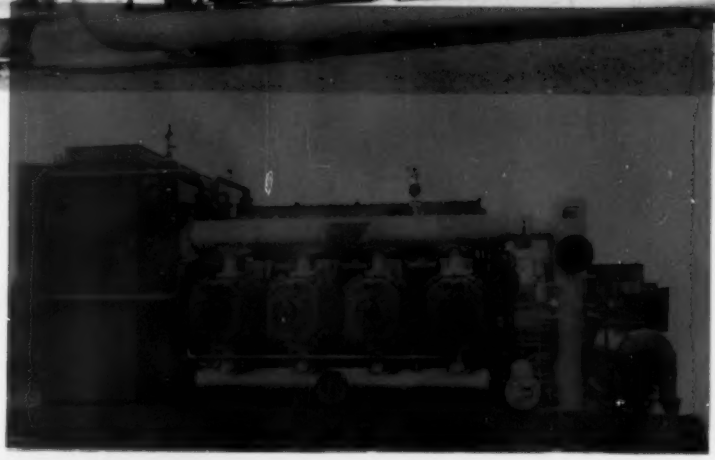
producing energy for an abundant life

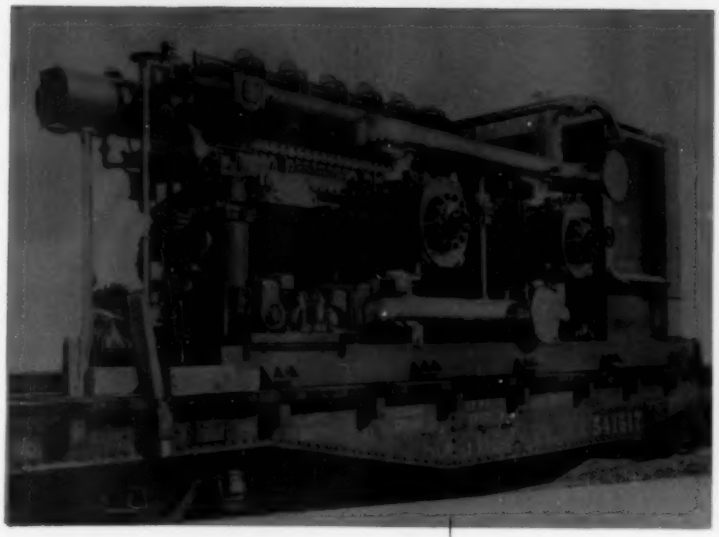
STANDARD OIL COMPANY (NEW JERSEY)

AND AFFILIATED COMPANIES



THERE'S MORE FLEXIBILITY IN THESE PACKAGE COMPRESSORS





Stearns-Roger's extensive manufacturing facilities and gas engineering personnel are exclusively responsible for your packaged compressor plant, from quotation to on-site operation. Our complete service assures you of a plant "custom built" to utmost efficiency and economy for the precise conditions of your field.

Each rugged, compact unit, with the compressor of your choice, is completely design-engineered just as are much larger permanent field installations. Stearns-Roger Packaged Compressor Plants provide quick, easy installation and substantially automatic operation. For every important service — process engineering, custom fabrication, field erection...

Ask for our Packaged Compressor Plant Bulletin, covering units from 100 H.P. up.

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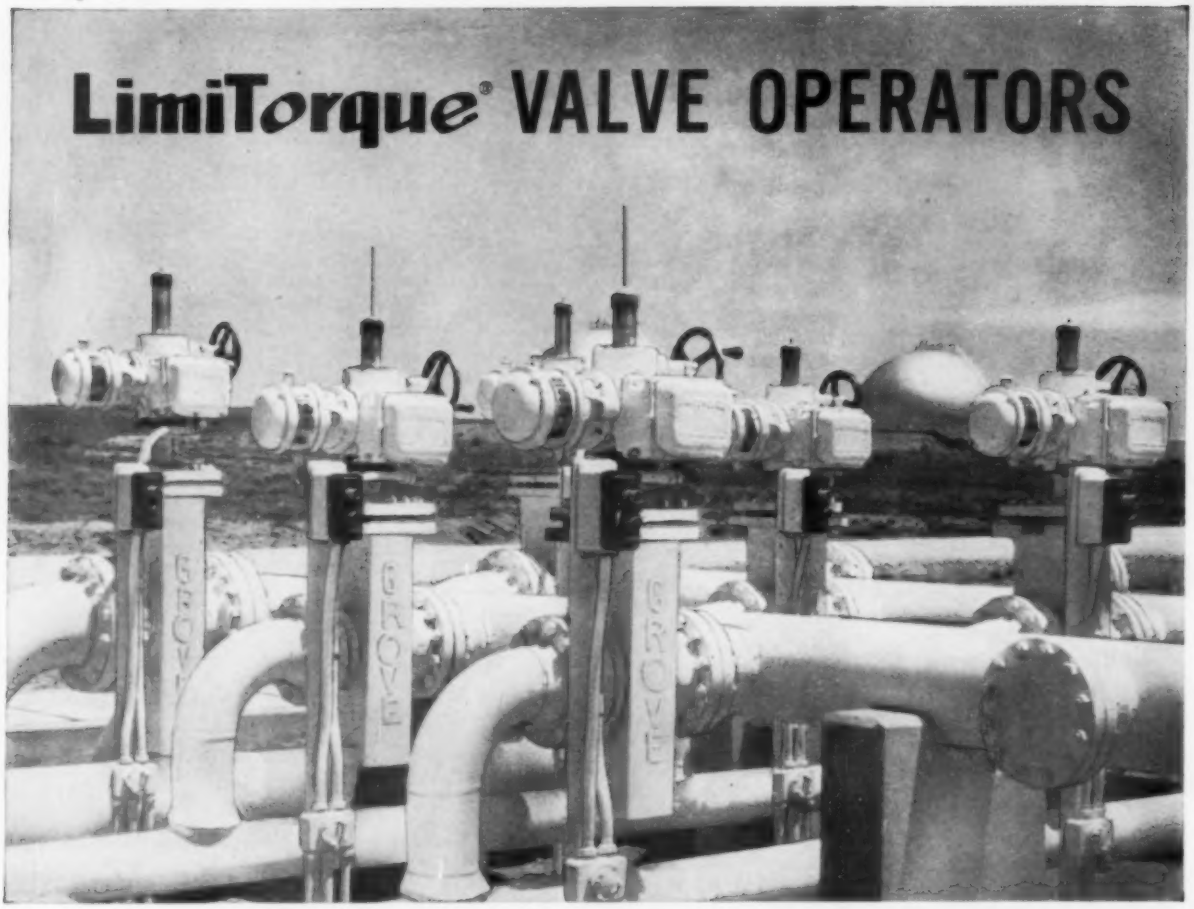
LimiTorque® VALVE OPERATORS



. . . are widely used at Product Pipeline Station of Okan Pipeline Company, Liberal, Kansas

In this Station, as in many other high pressure gas and oil transmission lines and refineries throughout the World, LimiTorque is automatically opening and closing valves from a conveniently located control point—eliminating guesswork and reducing labor costs—One man can operate any type of valve quickly and dependably in remote, inaccessible or hazardous locations; thus vital pipe line and refinery operating procedure can be handled easily by key personnel, safely and economically . . . Also, LimiTorque eliminates any possible damage to vital valve parts in closing, due to its unique torque limiting mechanism.

LimiTorque may be actuated by any available power source, such as Electricity, Oil, Gas, Air or Water; and is available for Micro-wave Control.

Send for Catalog L-550; and please use your Business Letterhead when requesting a copy.

LimiTorque®

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INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

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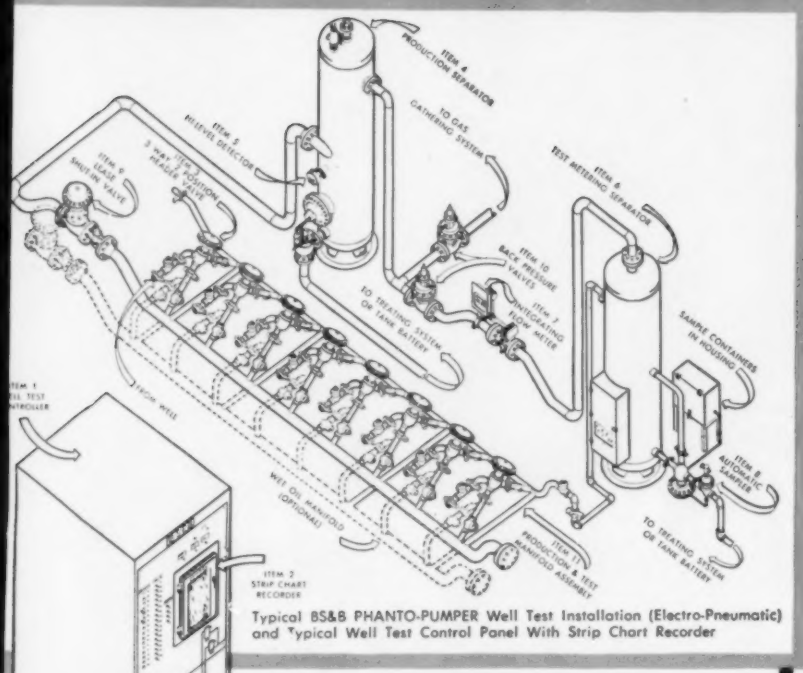
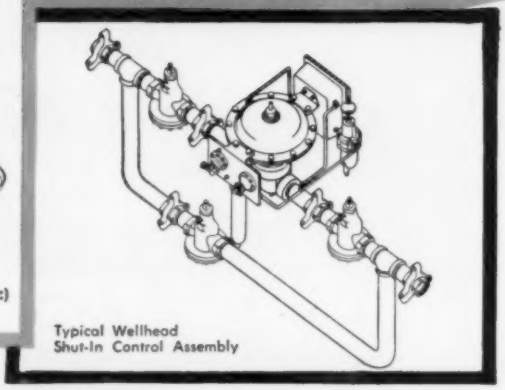
"BS&B Research Shows The Way!"

Only The New BS&B *Phanto-Pumper* Gives You Centralized Automatic . . .

- ✓ Wellhead Shut-In Control
- ✓ Well Test Control and Data Recording
- ✓ Well Flow Programming
- ✓ Tank Switching Control


ITEM 4 PRODUCTION SEPARATOR
TO GAS GATHERING SYSTEM
ITEM 6 TEST METERING SEPARATOR
ITEM 10 BACK PRESSURE VALVES
ITEM 7 INTEGRATING FLOW METER
SAMPLE CONTAINER IN HOUSING
ITEM 8 AUTOMATIC SAMPLER
TO TREATING SYSTEM OR TANK BATTERY
FROM WELL
WELL OIL MANIFOLD (OPTIONAL)
ITEM 11 PRODUCTION & TEST MANIFOLD ASSEMBLY
ITEM 2 STRIP CHART RECORDER

Typical BS&B PHANTO-PUMPER Well Test Installation (Electro-Pneumatic) and Typical Well Test Control Panel With Strip Chart Recorder



Typical Wellhead Shut-In Control Assembly

. . . Or Any Combination Of These In *One Packaged System!*

The BS&B PHANTO-PUMPER is that part of BS&B's new PHANTO-MATIC Lease System which automatically performs all lease operations between the wellhead and the gaging to the pipeline. It is the oil industry's first commercially available standard equipment for providing any combination of *centralized automatic* . . .

1. **Wellhead Shut-In Control** . . . Various types of wellhead shut-in control assemblies provide correct control for any combination of well flowing or pumping conditions.
2. **Well Test Control And Data Recording** . . . Wells are automatically switched from production to test and data is recorded on strip chart. Upon completion of test, well is automatically placed back into production and next well is put on test. Wells may be tested in any sequence, or for any time period.
3. **Well Flow Programming** . . . Production from wells is automatically programmed to meet state requirements. When allowable production has been reached, wells are automatically shut in.
4. **Tank Switching Control** . . . Tank battery control equipment automatically fills all tanks to capacity in a preset sequence, and automatically by-passes tanks already full or being run to pipeline, or to metering equipment.

The entire PHANTO-PUMPER System is designed "fail safe" so that in case of power failure or shut down, it will halt operations immediately until the trouble is remedied, and then will automatically start again at the same part of the sequence where it had ceased.

With the PHANTO-PUMPER System, the element of human error in lease operation is virtually eliminated by "set-and-forget" automatic controls which operate the system more accurately and economically than has ever heretofore been practical or possible.

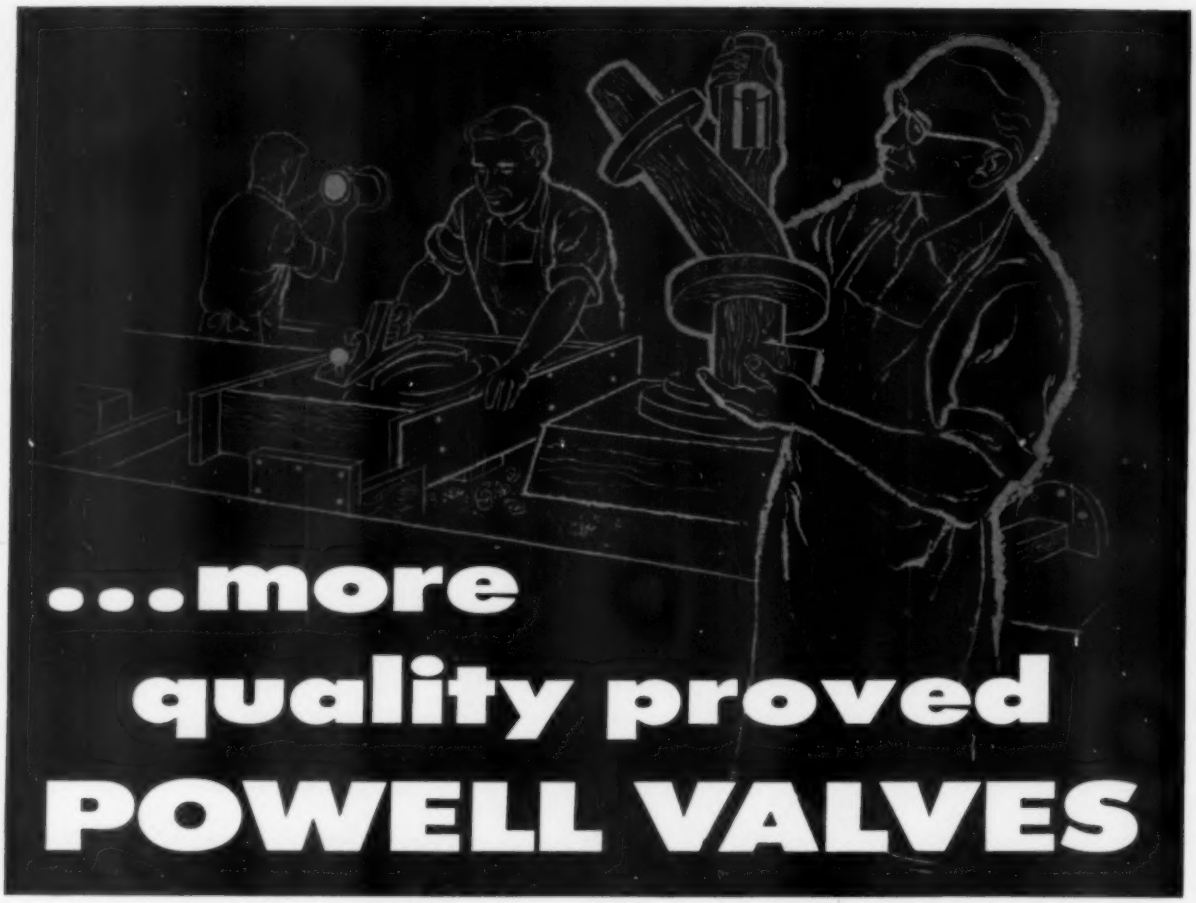
The BS&B PHANTO-PUMPER and the BS&B PHANTO-GAGER together make up the complete BS&B PHANTO-MATIC Lease System which provides full lease automation from the wellhead to the pipeline. PHANTO-GAGER Systems automatically perform the following functions:

1. Measurement and recording of temperature compensated oil volume in barrels.
2. Measurement (or automatic sampling and subsequent determination) of quality and contaminant.
3. Running of crude from lease into connecting pipeline in accordance with predetermined schedules on an unattended basis.

Ask Your BS&B Man For Full Details, or write to . . .

BLACK, SIVALLS & BRYSON, INC.

Oilfield Equipment Division, Dept. 1-A7A
P. O. Box 1714 Oklahoma City, Oklahoma



...more quality proved POWELL VALVES

Fig. 2201—175-Pound W.O.G. Semi-Steel Lubricated Plug Valve.

Fig. 86196—Steel "LPG" Horizontal Lift Check Valve for 400 W.O.G.

Fig. 375—Bronze Gate Valve for 200 Pounds W.S.P. Union Bonnet. Inside Screw Rising Stem.

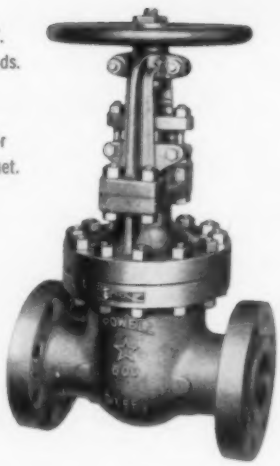


Fig. 6003—Steel O.S.&Y. Gate Valve for 600 Pounds.

for quality-crafted flow control

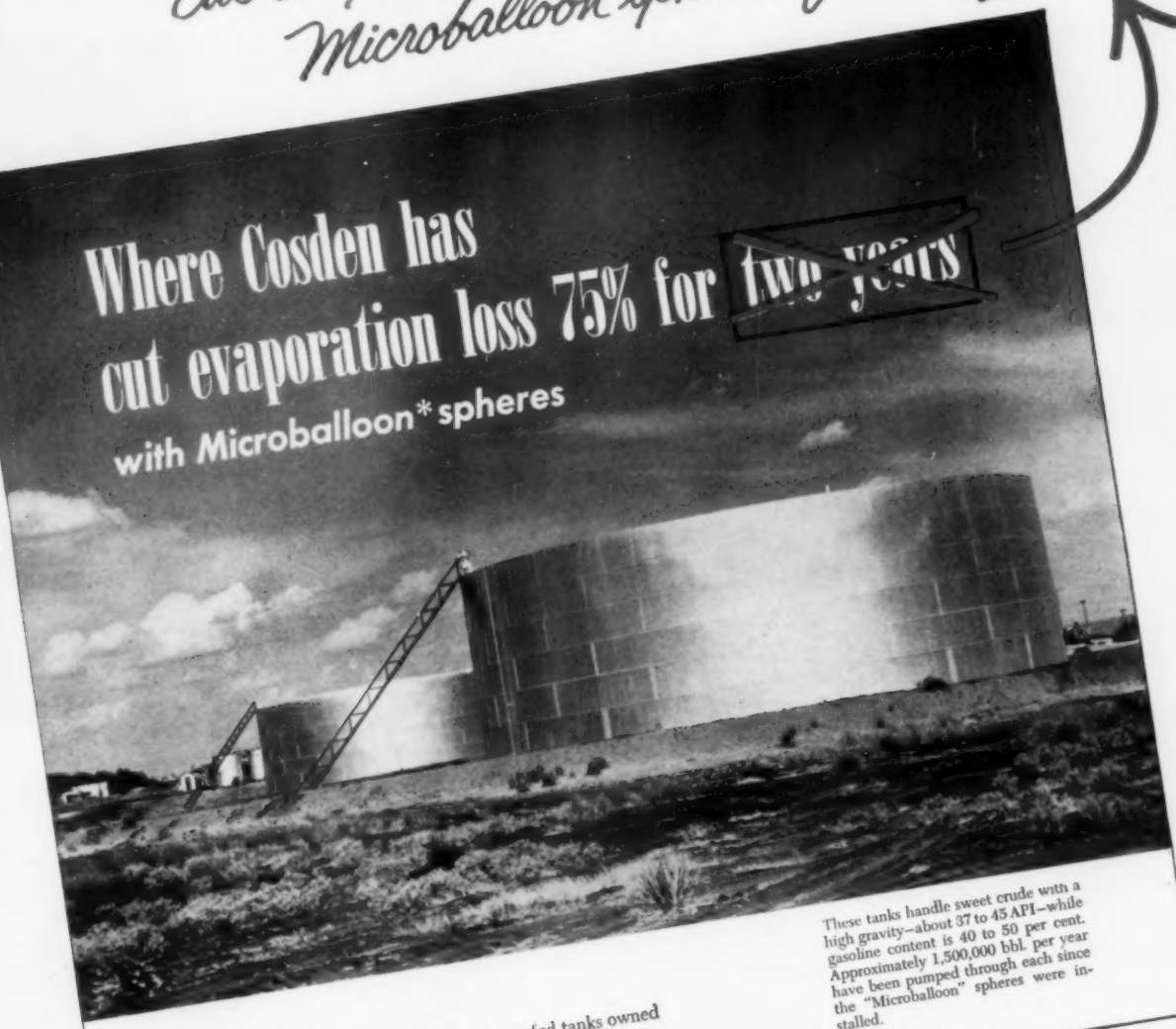
Ask your Powell Valve Distributor for the facts about quality-proved bronze, iron, steel and corrosion-resistant valves. Whatever your flow control problem, there's a Powell Valve to solve it.

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR

Now Cosden has cut evaporation loss with Microballoon spheres for 3 years

Where Cosden has cut evaporation loss 75% for ~~two years~~

with Microballoon* spheres



These tanks handle sweet crude with a high gravity—about 37 to 45 API—while gasoline content is 40 to 50 per cent. Approximately 1,500,000 bbl. per year have been pumped through each since the "Microballoon" spheres were installed.

In April, 1954, these 80,000-bbl. cone-roofed tanks owned by Cosden Petroleum Corp., Big Spring, Texas, were given a vapor-stopping seal of "Microballoon" spheres made from BAKELITE Brand Phenolic Resins.

Each tank was equipped with 4500 pounds of the spheres, which formed a foam seal on the oil surface. *After two years, this floating blanket is still effective.*

In that time, Cosden estimates it has reduced evaporation loss 75 per cent.

To learn more about this method of controlling evaporation, write today to Department XX-00.

For evaporation control...

BAKELITE BRAND

RESINS

UNION CARBIDE

*Registered trade-mark of The Standard Oil Co. (Ohio)

BAKELITE COMPANY, *Division of Union Carbide Corporation* UCC 30 East 42nd Street, New York 17, N. Y.

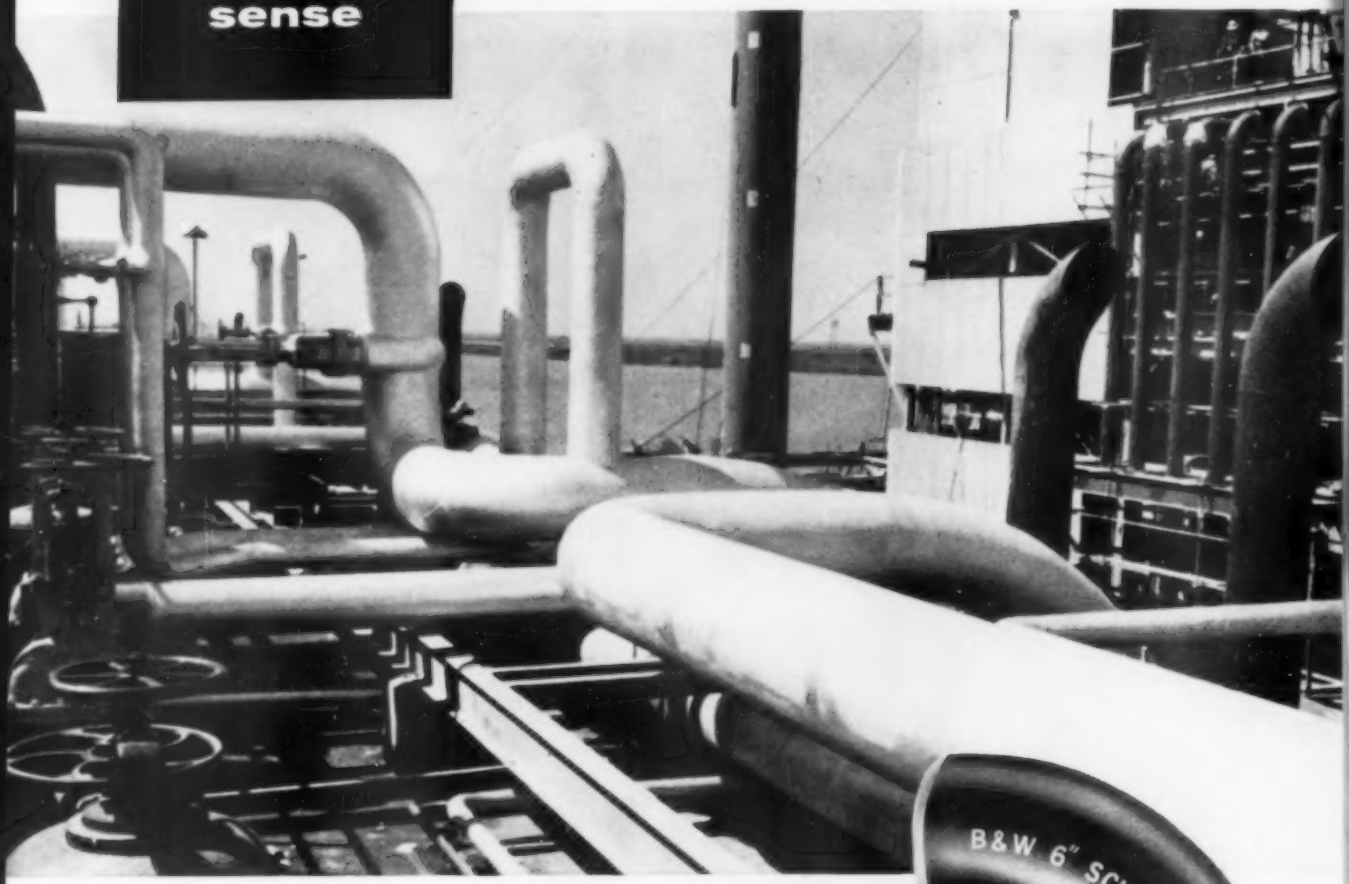
In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario

The terms BAKELITE and UNION CARBIDE are registered trade-marks of UCC.

This ad originally appeared in the January, 1957 issues of OIL & GAS JOURNAL and PETROLEUM WEEK

result of an engineer's good common sense

insulation is easier and faster to apply when seamless welding fittings are used



THANKS to the engineer who specified B&W Seamless Welding Fittings, no humps or bumps had to be insulated here. Welding fittings became an actual part of this smooth, streamlined piping. And with a sound weld, welded connections are leakproof, pipelines are permanent. Insulation never has to be restored because of leaky joints. Therefore, maintenance is practically non-existent.

Seamless Welding Fittings combine strength with lightness-in-weight and allow closer nesting. B&W's dimensional accuracy such as full radius, true circularity and smooth walls of uniform thickness permits uninterrupted flow even under highest temperatures and pressures.

Be sure — and specify B&W Seamless Welding Fittings and Forged Steel Flanges. They're available in a complete range of sizes and types in carbon steel and the B&W CROLOYS.

THE *NATURAL* SOURCE FOR ALLOY FITTINGS

B&W

TUBULAR PRODUCTS DIVISION

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION • FITTINGS DEPARTMENT
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FA-7906-FE-2

Seamless welding fittings and forged steel flanges, seamless and welded tubular products — in carbon, alloy and stainless steels.

Pioneering the World's Largest

★ 20 Ft. FAN
★ 3750 H.P.
★ COOLER . . 30 Ft. LONG
. . 26 Ft. WIDE

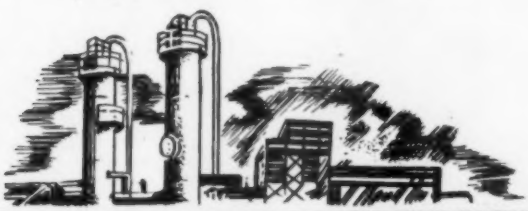
SINGLE AIR-COOLED HEAT EXCHANGER

Smithco Engineering Inc. is proud to have been a part of the remarkable satellite station recently installed by Gulf Interstate Gas Company in Stanton, Kentucky.

Smithco Engineering developed a unique design for this application which has proven to be completely reliable and trouble-free.

For outstanding quality and reliability always look to Smithco.

THE *FIRST* OF ITS KIND!



Plant & Offices — Tulsa, Oklahoma

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Representatives in the Petroleum Industry

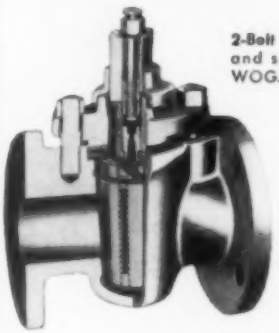
SMITHCO
Engineering Inc.

Cut flow control costs... standardize on...

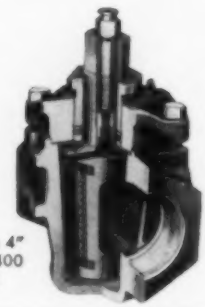
THE WORLD'S MOST COMPLETE

LUBRICANTS and

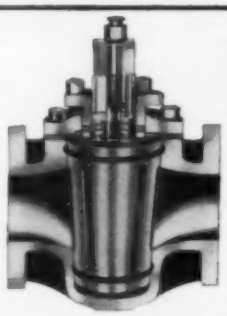
VALVES



2-Bolt Cover Type Valve in 4" and smaller sizes for 175-lb WOG. *Semi-Steel*

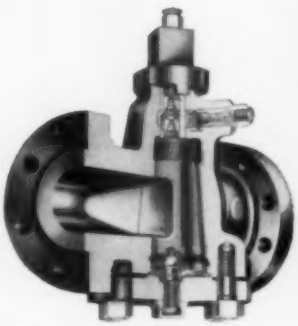


Screwed Gland Type Valve in 4" and smaller sizes for 200, 400 and 500-lb WOG. *Semi-Steel*



Bolted Gland Type Valve in 4" to 36" for 200 through 800-lb WOG Semi-Steel and ASA 150-lb and 300-lb Carbon Steel.

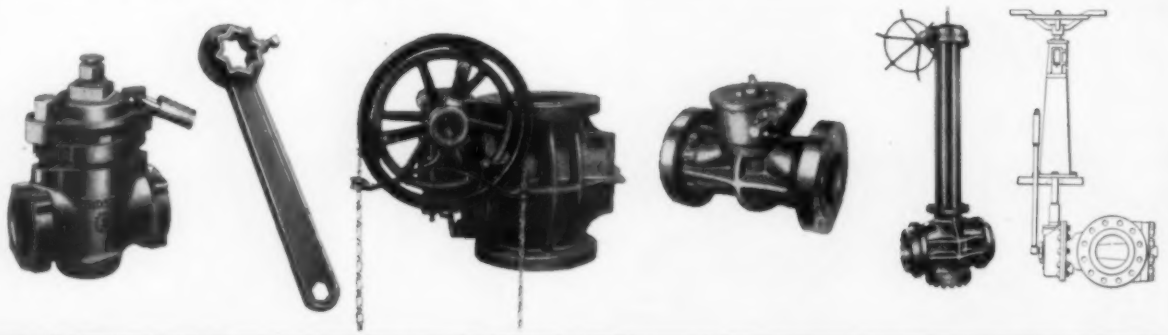
Hypreseal Valve—Bolted Bottom Cover Type. ½" to 30 by 34" for ASA 150-lb through 1500-lb Carbon Steel (with rectangular opening). API 2000-lb and 3000-lb WOG Alloy Steel Rectangular Opening. API 2000 and 3000-lb WOG Alloy Steel (with round opening).



LUBRICANTS

PROPER VALVE LUBRICATION means longer valve life and better performance at lower cost. Rockwell is the world's oldest and most experienced manufacturer of lubricated plug valve lubricants. To assure perfect performance, a *complete line* of lubricants has been developed and field proved. For convenience, they are available in stick, tube and bulk forms. The Rockwell High Pressure Booster Type Hand Gun and Rockwell High Pressure Booster Type Bucket Gun make the lubrication of even a great number of valves a job that takes only minutes.

ACCESSORIES

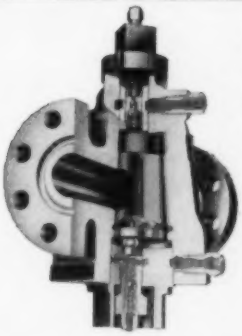


GREATER DESIGN AND INSTALLATION FREEDOM are the "extras" you get when you specify Rockwell-Nordstrom valves and accessories. No matter what your operating requirements or problems, you can select from a *complete* line of valve accessories that assure easier, safer, more efficient operation.

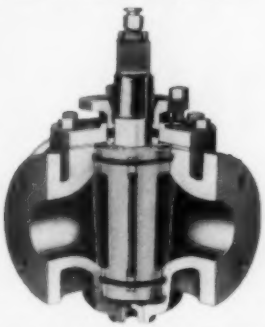
While only a few of the valve accessories are shown above, you can learn about the complete selection by talking with your Rockwell-Nordstrom sales engineer or writing directly to: Rockwell Manufacturing Company, 400 N. Lexington Avenue, Pittsburgh 8, Pennsylvania.

LINE OF LUBRICATED PLUG VALVES,

ACCESSORIES



Hypreseal Valve—Screwed Bottom Cover Type. ½" to 8" for 7500-lb WOG Alloy Steel (rectangular opening). ASA 2500-lb Carbon Steel (rectangular opening). API 5000-lb and 10,000-lb WOG (rectangular opening) and API 5000-lb and 10,000-lb WOG (round opening).



Multiport Valve Type. Available in Gland type and Hypreseal type in WOG pressures to 400 lb and ASA pressures to 1500-lb. Sizes from ½" to 24".

ALL THESE ADVANTAGES

In *Every* Rockwell-Nordstrom Valve.

LEAKPROOF: Lubricant sealing is a *double* seal against leakage.

LONG-LIFE: Lubricant prevents metal-to-metal wearing friction.

LOW-COST: Lubrication is preventive maintenance.

DEPENDABLE: Hydraulic lubricant action jacks plug for instant operation.

QUARTER-TURN OPERATION: 90° turn for *full* positive shut-off.

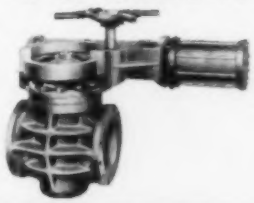
SMOOTH PASSAGE: Straight-through flow without crevices . . . minimum pressure drop.

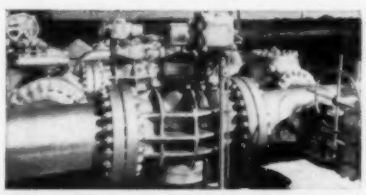
UNEXPOSED SEATS: Corrosion and erosion eliminated in vital seat areas.

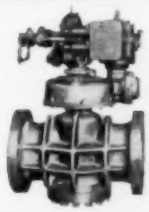
ADJUST, LUBRICATE UNDER PRESSURE: Never down time for routine servicing.

No other valve—at any price—can offer the performance and longer life at lower cost of Rockwell-Nordstrom valves.

POWER OPERATORS



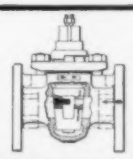




AUTOMATIC VALVE OPERATION is more dependable and economical when you specify Rockwell-Nordstrom valves. They are far superior to ordinary valves for power operation because *lubrication* reduces operating torque—smaller, less costly actuators can be used. And since there are no forced, wedged seats to be set, the actuator has only to move the lubricated plug through 90°.

Typical electric, pneumatic and cylinder operators shown above represent only three of the more than fourteen power operation arrangements available.

VALVES WITH SPECIAL FEATURES



NO MATTER WHAT YOUR NEEDS, there is a Rockwell-Nordstrom valve that will do the job better, longer and at lower cost. A few of the Rockwell-Nordstrom valves with special features are shown above.

Special metal valves are available in stainless-steel, bronze and other corrosion resisting alloys for even the toughest services. Valves with *hard faced plugs and bodies* combine the economy of semi-steel with hard facing for utmost corrosion and wear resistance. *Steam jacketed valves* for precise product temperature control. *By-pass relief valves* prevent pressure build-up that imposes dangerous stress on ordinary valves and fittings. *Gas safety control (Factory Mutual) valves* for positive control against explosion in multi-burner gas-fired furnaces, ovens and driers.

* * * *

Rockwell-Nordstrom valves and accessories are available at leading oil field and industrial distributors everywhere. For full information write: Rockwell Manufacturing Company, 400 N. Lexington Avenue, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

Lubricant Sealed For Positive Shut-off

AND HERE'S ANOTHER NUMBER TO REMEMBER

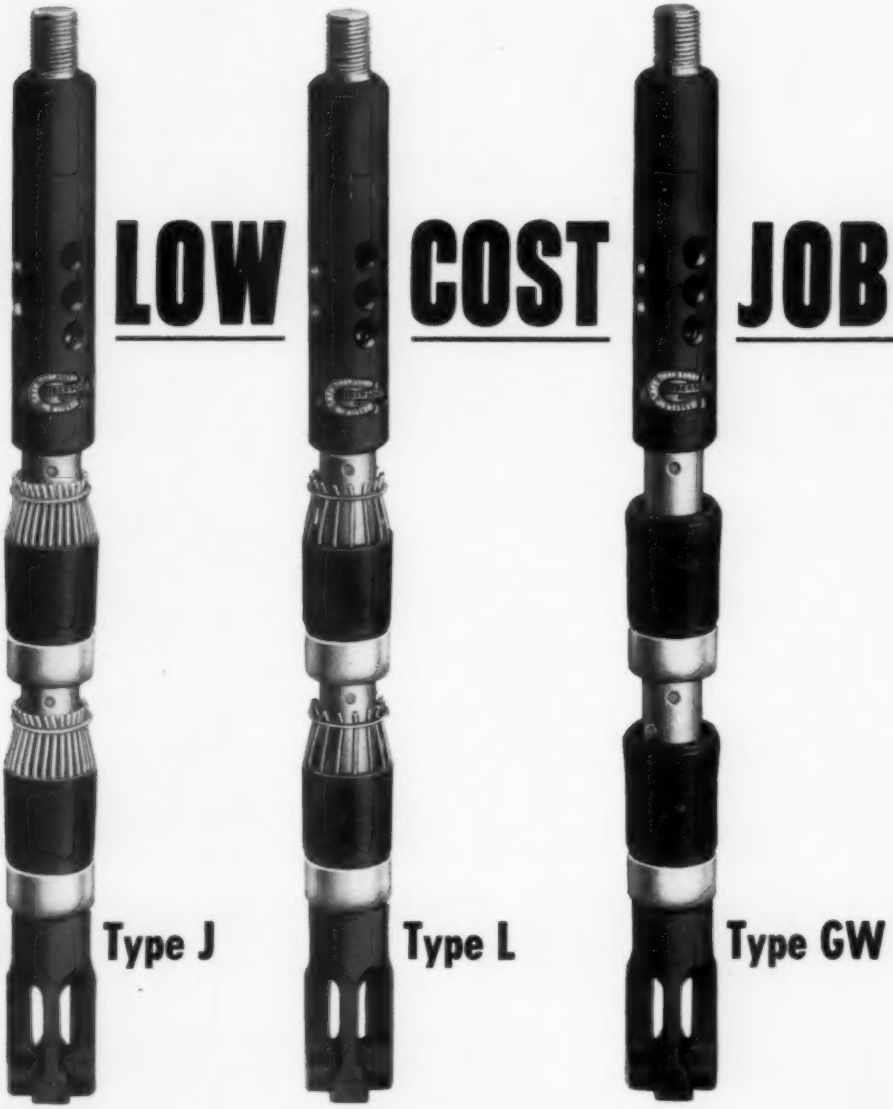
LINE PIPE IN ACCORDANCE WITH AMERICAN PETROLEUM INSTITUTE SPECIFICATIONS

WHEATLAND TUBE COMPANY

BANKERS SECURITIES BLDG., PHILA. 7, PA. MILLS • WHEATLAND, PA. • DELAIR, N. J.

GUIBERSON SWABS DO A

GOOD LOW COST JOB!



GUIBERSON'S Type J Type L Type GW

Here are three swabs capable of swabbing all sizes of tubing and drill pipe — in a minimum of time — making them most economical and efficient for routine swabbing. Many other types of Guiberson cups are immediately available for *specific* and *unusual* swabbing problems.

SAFE THAN SORRY BETTER BE GUIBERSON

THE GUIBERSON CORPORATION

ESTABLISHED 1919
DALLAS, TEXAS
U. S. A.

ONE OF THE DRESSER INDUSTRIES

Sold by Oil Field Supply Stores Everywhere

These valves will

NEVER NEED "LUBRICATION"

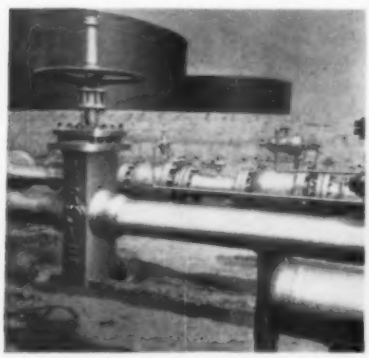
Grove Seal-O-Ring Gate Valves eliminate these costly maintenance and operating problems:

- No lubricants or sealing compounds needed
- No time or labor wasted in lubrication
- No sticking due to loss of lubricant
- No leaking from failure to lubricate
- No damaged gates or seats caused by improper lubrication
- No contamination of product or fouling of adjacent metering or control equipment

The squeegee action of the exclusive *Seal-O-Rings*, which are always in contact with the gate, wipes both sides immaculately clean. This maintains precision factory finish on the sliding surfaces, insuring full freedom of movement – without need for lubricants or sealing compounds. Bearings and stem seals are factory packed for a lifetime of normal service. For 2" to 36" lines – for oil, water, gas – specify *Seal-O-Ring*, the gate valve that's proved it can take care of itself year in and year out.

704

Write for colorful new Pipeline Valve Bulletin No. G-571



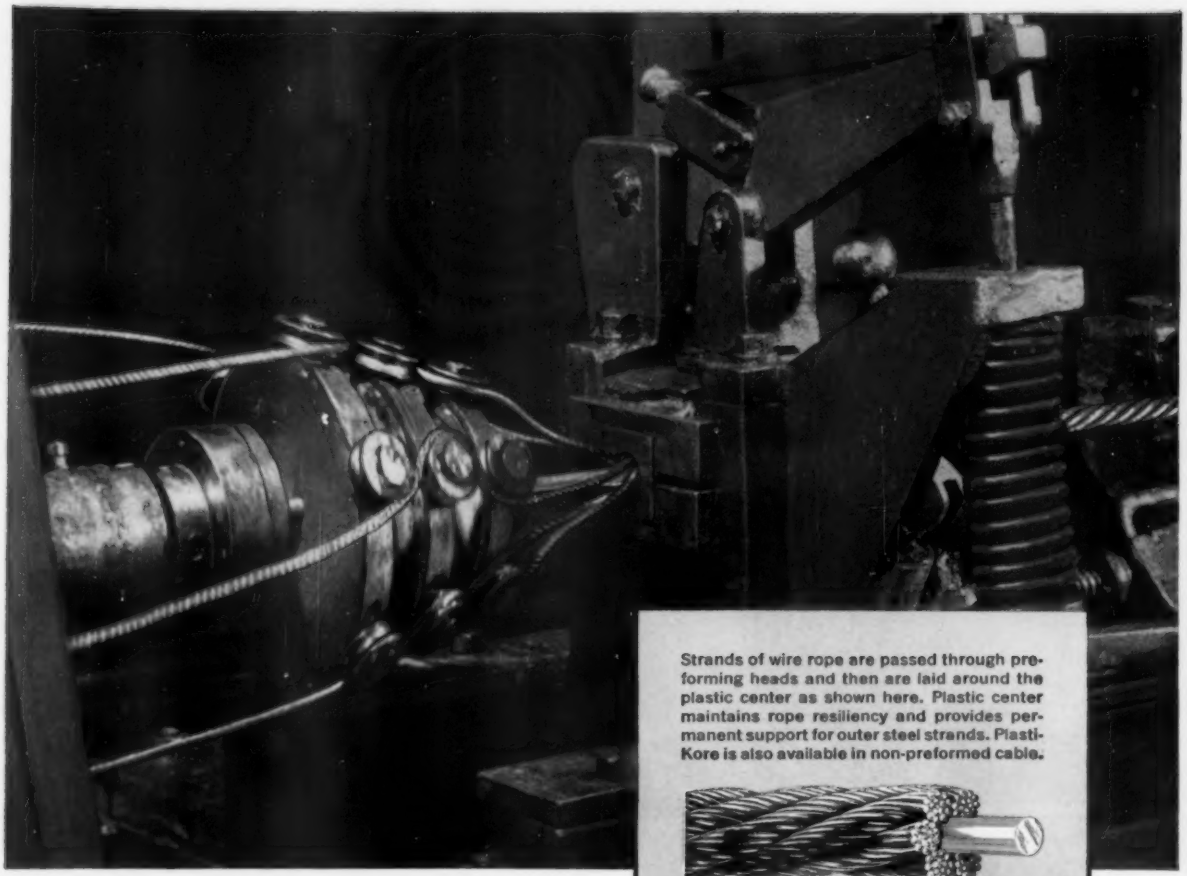
GROVE SEAL-"O"-RING Gate Valves

SUBSIDIARY OF WALWORTH

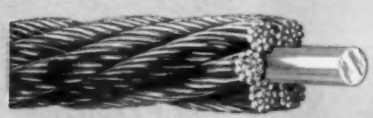
GROVE VALVE and REGULATOR COMPANY • 6529 Hollis St., Oakland 8, Calif.
HOUSTON 23—3517 Polk Ave. • • • • • LOS ANGELES 6—1930 W. Olympic Blvd.

GROVE SEAL-O-RING ® GROVE SIMPLICITY ACCURACY SAFETY

ODESSA, TEXAS • TULSA, OKLAHOMA • CHICAGO, ILLINOIS • DENVER, COLORADO • In Western Canada: GROVE VALVE LIMITED, EDMONTON



Strands of wire rope are passed through preforming heads and then are laid around the plastic center as shown here. Plastic center maintains rope resiliency and provides permanent support for outer steel strands. PlastiKore is also available in non-preformed cable.



why PLASTIKORE wire rope gives you real "snap action"

PlastiKore wire rope has many advantages for use as cable tool drilling lines, sand lines and swabbing lines. The plastic core provides a uniform strength and toughness throughout the length of the line. This results in flexibility with the "snap action" you want.

The plastic center is unaffected by acids, caustics, and water that destroy fiber cores. PlastiKore wire rope gives you long service life despite these rigorous operating conditions.

PlastiKore holds a uniform diameter in the high strain areas of the drum and sheave. Plastic center provides a uniform cushion for the outer strands and maintains strand clearance, thus preventing internal binding. Send coupon today for complete information on PlastiKore.

Jones & Laughlin Steel Corporation
Wire Rope Division
Muncy, Pennsylvania

☐ Please send literature on PlastiKore.

☐ Have representative call.

Name_____

Title_____

Company_____

City_____ Zone_____

State_____

JL STEEL

Jones & Laughlin

...a great name in steel

Struthers Wells

STOCK
Heat Exchangers
Save you money!

Code Equipment at Production Prices

Struthers Wells standard stock heat exchangers have secured a wide acceptance in the process industries.

The illustration shows a partial view of units currently in stock. Equipment is available from stock in sizes from 20 to 300 square feet of surface—including fixed tube sheet, floating head and U-tube units.

Condensers, coolers, heaters, and reboilers can be supplied in single and multi-pass tube arrangement.

Standard heat exchanger construction includes materials of carbon steel, non-ferrous alloy, and stainless alloys Type 304 and Type 316. Equipment meets highest construction standards, including ASME Code and TEMA Class A.

Standardization of design and quantity production enables us to offer this equipment at a very reasonable cost.

Price sheets and standard data are available on request; please address us on your letterhead.

STRUTHERS WELLS PRODUCTS

PROCESSING EQUIPMENT DIVISION

Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

BOILER DIVISION

BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

FORGE DIVISION

Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

MACHINERY DIVISION

MACHINERY for Sheet and Structural Metal Forming . . . Tangent Benders . . . Folding Machines . . . Roller Table and Tumble Die Bending Machines . . . Press Brakes . . . Punching and Notching Machines . . . Forming Dies

ANY SIZE AVAILABLE FOR QUICK DELIVERY

STRUTHERS WELLS *Corporation*

Struthers Wells

WARREN, PA.

Plants at Warren, Pa. and Titusville, Pa.

Offices in Principal Cities

They Say—

Better-management series

Dear Sir:

I want to take this opportunity to congratulate you on the excellent series of articles in your better-management series: "The Functions of Leadership," and to thank you for the copies of articles 1 and 2.

Our maintenance supervisors here at Adams Terminal are finding these articles to be interesting reading and a very helpful source of guidance. I would appreciate receiving 18 copies of article 3 in the June 10 issue of The Oil and Gas Journal.

S. C. Naifeh
Services Superintendent
Phillips Chemical Co.
Adams Terminal
Pasadena, Tex.

Editor's note: The copies are being sent. Journal readers also can obtain the free copies of the following articles from this series by writing: Editorial Department, P. O. Box 1260, Tulsa.

Article—	Issue	Page
Tips on Trainee Instruction	1-21-57	121
Tips on Training—1	2-25-57	151
Tips on Training—2	3-18-57	159
The Functions of Leadership—1	4-15-57	145
The Functions of Leadership—2	5-13-57	157
Some Tips on Planning	6-10-57	129

Gravity interpretations

Dear Sir:

It was a pleasure to read your article on gravity surveys in The Oil and Gas Journal, June 17. The history, applications, and place in the industry of gravity are very well outlined. I particularly liked the emphasis that was put on the interpretation of gravity by relating it directly to specific geologic features.

To get the full benefit of a gravity survey, the interpreter should stress the methods of imaginative geology; if he does this he will often gain more information from a gravity survey than he thought possible.

Frederick Romberg
Manager
Geophysical Service, Inc.
Houston.

When a success can fail

"There is a constant danger of successing ourselves out of business. The expenses involved in some discoveries—even big discoveries, if in isolated areas, for example, may suddenly develop to

DRAFTING TRENDS

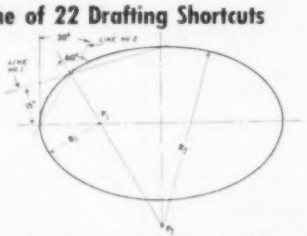
This free booklet, newly developed by the Frederick Post Company through the co-operation of leading engineers and draftsmen, shows 59 shortcuts to speed drafting and computation work.

Ideas for increasing drafting and engineering efficiency

POST went to leading engineers and draftsmen and asked them what techniques they use to save time without sacrificing precision in their work. From the many interesting tips and drafting shortcuts suggested, a total of 59 have been compiled into one handy booklet called "Time Saving Tips for the Draftsman and Engineer."

Clearly written and well illustrated, this booklet shows new approaches to old problems. The section on CALCULATING IDEAS contains 10 tips including easy ways of "Remembering the Signs of Trig Functions," "Dividing a Circle Into Parts," and "Locating Decimal Points."

One of 22 Drafting Shortcuts



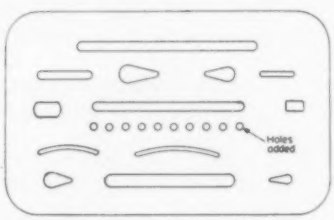
Here is what seems to be the fastest and easiest method of constructing an approximate ellipse: (1) Draw a line at 15° to major axis as shown. (2) Draw a line at 30° to minor axis as shown. (3) Draw a line at 60° to line #2 through intersection of lines #1 and #2. (4) Draw Arc R_1 from point P_1. (5) Draw Arc R_2 from point P_2.

9 tips in Engineering Data Section

Easy-to-use, practical shortcuts to formulas and other engineering data are featured in this section. Two of these time savers are faster methods of "Determining Gear Inertia" and "Interpolating Between Family of Curves."

One of 18 Board Timesavers

Fairly often when drafting it becomes necessary to change a solid line to a dotted line. By placing a series of holes in an erasing shield, as shown, it is possible to make the conversion simply by erasing through the holes.



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the point where it costs more money to produce the oil than we could ever hope to regain from sale of the product.

"This losing battle is not unique to the oil business, but it is a factor which must be faced, a danger which we must constantly guard against."

R. R. Robison, Shell Oil Co., in a speech before the Western States Gas Tax Officials convention.

A fallacy in taxing business

"The future is beclouded by . . . ideological hazards to which we are not yet fully alert . . . Among these, perhaps, none is more immediate—nor more dangerous in the long run—than the widely expounded doctrine that big business is a menacing evil which must be atomized in the national interest.

"This issue . . . in its most dangerously deceptive form is masquerading as an aid to small business in a rash of measures which would impose a graduated or progressive income tax on corporations . . .

"There is a basic fallacy in any proposal to levy a graduated tax on corporate income. Regardless of its justification, when a graduated tax is levied on an individual, it is based, at least in theory, upon his ability to pay. But a corporation is not an individual. It is a group of individuals who have pooled their resources and their skills to perform some service . . . And no tax that is levied upon a group of individuals, collectively, bears any relationship whatever to their individual ability to pay."

Roger M. Blough, chairman of the board, United States Steel Corp., in a speech at the general meeting of the American Iron and Steel Institute, New York.

Can states act on imports?

"There is more than one way to skin a cat . . . and the United States Supreme Court may find every one of them. This time it probably has inadvertently solved the problem created for domestic oil producers by the steady importation of foreign crude.

"Probably nothing was further from the court's mind when it handed down the Gulf Oil Corp. vs. Oklahoma Corporation Commission decision . . . Gulf had sought to reduce its purchases of Oklahoma crude . . . The Commission had a rule that it might, or would not, grant such relief from the monthly production allowable schedule it issues, but Gulf contended such a procedure was an unconstitutional burden on interstate commerce and sought to act on its own. The Supreme Court refused to disturb the commission procedure.

"If all the oil states institute the same

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Tube Turns announces a new lightweight welding neck flange for service up to 125 lbs. W.O.G. pressure, offering two important cost-cutting advantages: (1) It is priced lower than conventional flanges. (2) This lightweight welding neck flange has a tapered face which affords an effective seal with reduced bolt loading; hence, permits use of steel butt welding neck flanges without danger of cracking the flat faced cast iron flanges of valves and pumps used in low pressure piping systems. Here is another result of Tube Turns pioneering research, and an example of how you get *more for your money* when you specify TUBE-TURN Welding Fittings and Flanges and buy them from your nearby Tube Turns' Distributor.

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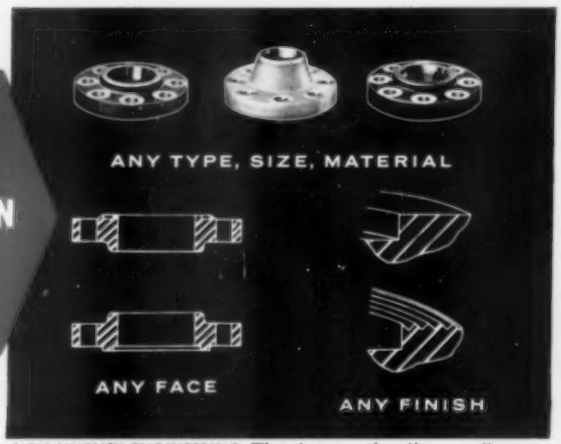

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practice Oklahoma has and state courts do not interfere in behalf of the purchasers . . . might the state regulatory commissions not determine that the total of their allowables would equal all of the petroleum the domestic companies require . . . or nine-tenths of the amount, which is about the ratio recommended in 1955 by the President's committee?"

Editorial in the Tulsa Tribune.

Octane number's price tag

"The compression ratio of automobile engines is rising by about half a point per year, and is expected to go on rising at this rate during the next few years. An increase of half a point in motor compression requires an increase of 1½ points in the octane number of motor fuels. The plant investment required for an increase of 1½ points in octane number of all the gasoline we sell in 1957 is about $20 million. Moreover, each additional rise in octane number entails a larger capital outlay than in the last."

J. R. White, president, Imperial Oil, Ltd., in a statement to shareholders.

Widespread import effects

"The damaging effects of excessive imports are apparent. The economy of the oil-producing states is being seriously impaired. These states are being denied vital tax revenues from oil production. These unhealthy conditions mean reduced purchasing power for goods produced in all other states throughout the country."

Robert L. Wood, president, Independent Petroleum Association of America.

Article Guides available

Dear Sir:

I have received your very convenient and helpful Article Guide which I have begun to use already.

This sort of service by your organization, it seems to me, is in a spirit of real service to busy specialists, and represents advanced thinking and action that is sorely needed, and should be greatly appreciated by the people who are responsible for the continued flow of petroleum products to the general public.

Cecil M. Cooper
Equipment Inspector
Standard Oil Co. of California
El Segundo, Calif refinery.

Editor's note: Many thanks for the nice words from refinery subscriber Cecil M. Cooper. Some extra copies of the Journal's new Article Guides are available, single copies without charge. At present there are two separate book-

10 drillers ran three-quarter million feet of hole
and again proved
NATIONAL
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In a recent field check, ten drillers specified the exact jobs their National Torque Converters had been doing.
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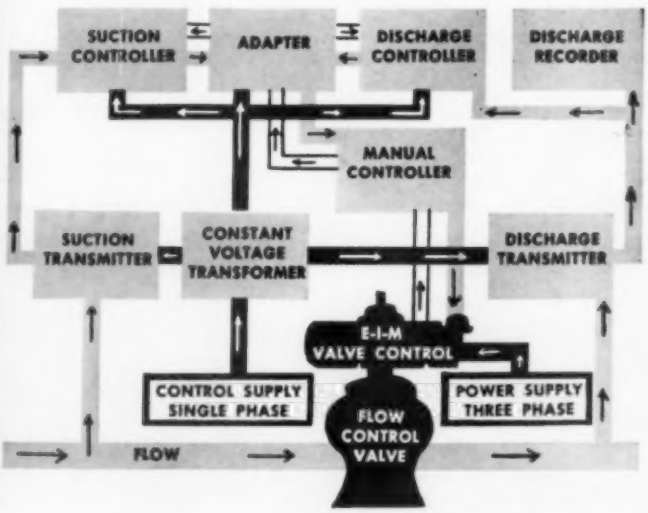

lets: No. 1 covers drilling and production subjects (also includes geology and geophysics); No. 2 is on refining and petrochemicals.

These new Article Guides are a combination index and literature guide—plus a digest. You can use them as quick references for important articles and information regarding your divisions of the industry. For your free copy, write the Journal's Reader Service Dept., P. O. Box 1260, Tulsa, designating whether you wish the drilling-production booklet or the refining-petrochemicals booklet.

CALENDAR OF EVENTS

JULY

8-19 Industrial Statistics for the Process Industries, second annual conference, sponsored by American Society for Quality Control and the University of Oklahoma, Lockett Hotel, Norman, Okla.

AUGUST

1-3 Rocky Mountain Mineral Law Foundation, third annual institute, Montana State University, Missoula, Mont.

19-20 North Dakota Oil and Gas Association, annual meeting, Bismarck, N. D.

26-28 Seventeenth annual Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

28-30 Instrument Society of America, International Symposium on gas chromatography, Kellogg Center, Michigan State University, East Lansing, Mich.

SEPTEMBER

3-5 Pacific Coast Gas Association convention, Fairmont and Mark Hopkins Hotels, San Francisco.

5-7 New Mexico Geological Society, eighth annual field conference, southwestern Colorado.

8-13 American Chemical Society, 132nd national meeting, New York City.

9-10 Independent Natural Gas Association of America, annual meeting, Shamrock Hilton Hotel, Houston.

9-11 American Institute of Electrical Engineers, petroleum industry conference, Sheraton Hotel, Philadelphia.

11-13 National Petroleum Association, fifty-fifth annual meeting, Traymore Hotel, Atlantic City, N. J.

19-21 Rocky Mountain Oil Show, fairgrounds, Casper, Wyo.

22-25 American Society of Mechanical Engineers, petroleum mechanical engineering conference, Mayo Hotel, Tulsa.

23-25 American Society of Mechanical Engineers, fall meeting, Statler Hotel, Hartford, Conn.

26-27 Western Petroleum Refiners Association, Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

26-27 Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, Roosevelt Hotel, New Orleans.

30-Oct. 2 American Oil Chemists' Society, 1957 fall meeting, Netherland Plaza Hotel, Cincinnati.

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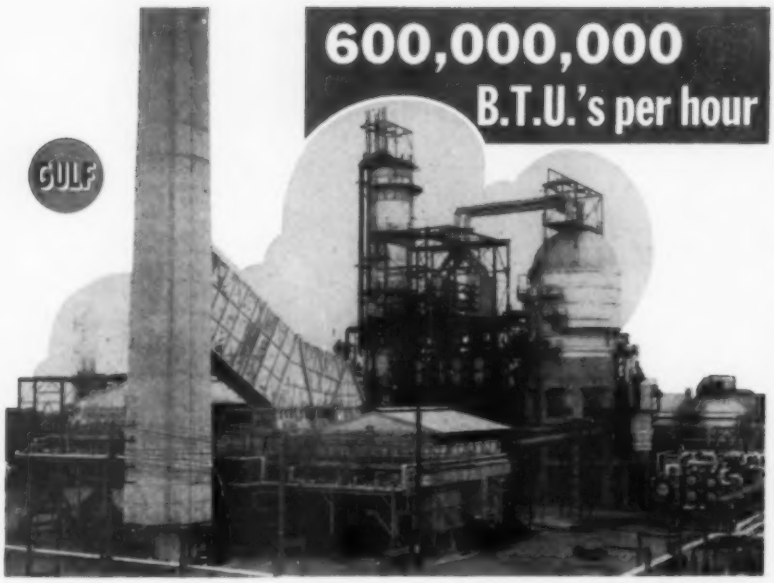

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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

OCTOBER

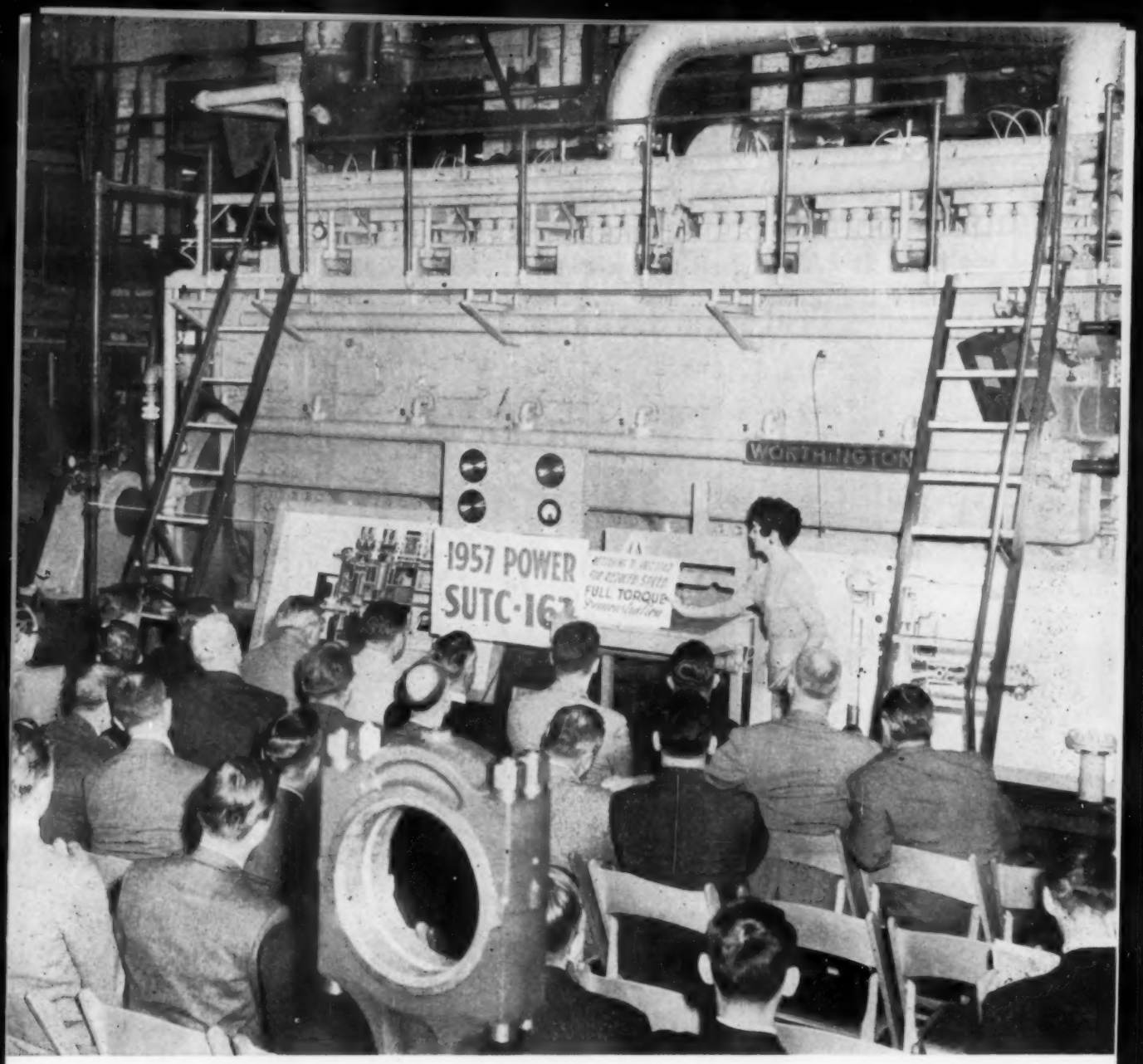
- **1-2** Texas Mid-Continent Oil and Gas Association, thirty-eighth annual meeting, Texas Hotel, Fort Worth.
- **2-4** Golden Trend Oil Show, Pauls Valley, Okla.
- **6-9** Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, fall meeting, Adolphus, Baker, and Statler Hilton Hotels, Dallas.
- **7-9** National Electronics Conference, thirteenth annual meeting, Hotel Sherman, Chicago.
- **7-9** American Gas Association, annual convention, Kiel Auditorium, St. Louis.
- **7-11** American Institute of Electrical Engineers, fall general meeting, Morrison Hotel, Chicago.
- **10-11** California Natural Gasoline Association, thirty-second annual fall meeting, Huntington-Sheraton Hotel, Pasadena.
- **10-12** American Society of Mechanical Engineers, American Institute of Mining, Metallurgical & Petroleum Engineers, fuels conference, Chateau Frontenac, Quebec.
- **13-15** American Association of Oilwell Drilling Contractors, seventeenth annual meeting, Mayo Hotel, Tulsa.
- **13-19** OIL PROGRESS WEEK.
- **17-18** American Institute of Mining, Metallurgical, and Petroleum Engineers, Southern California petroleum section, fall meeting, Biltmore Hotel, Los Angeles.
- **17-19** Four Corners Geological Society, second field conference, Gallup, N. M.
- **18** American Institute of Chemical Engineers, South Texas section, twelfth annual technical meeting, Moody Convention Center, Galveston, Tex.
- **20-22** National Association of Oil Equipment Jobbers, annual convention and trade show, Hotel Peabody, Memphis.
- **24-25** Western Petroleum Refiners Association, regional technical-industrial relations meeting, Rufus Garrett Hotel, El Dorado, Ark.
- **25** Natural Gasoline Association of America, southern regional meeting, Washington-Youree and Captain Shreve Hotels, Shreveport.
- **27-29** Independent Petroleum Association of America, annual membership meeting, Statler Hilton Hotel, Dallas.
- **31-Nov. 1** American Association of Petroleum Geologists, Mid-Continent regional meeting, Cimarron Ballroom, Tulsa.

NOVEMBER

- **3-8** Society for Nondestructive Testing, second international conference, Hotel Morrison, Chicago.
- **6-8** Gulf Coast Association of Geological Societies, seventh annual convention, Roosevelt Hotel, New Orleans.
- **6-8** Society of Automotive Engineers, national fuels and lubricants meeting, Hotel Statler, Cleveland.
- **11-14** American Petroleum Institute, thirty-seventh annual meeting, Conrad Hilton Hotel and Palmer House, Chicago.
- **22** Natural Gasoline Association of America, Panhandle Plains regional meeting, Herring Hotel, Amarillo, Tex.

DECEMBER

- **1-3** Interstate Oil Compact Commission, annual meeting, Tulsa.
- **1-6** American Society of Mechanical Engineers, annual meeting, Statler Hotel, New York.
- **8-11** American Institute of Chemical Engineers, annual meeting, Conrad Hilton Hotel, Chicago.



At 1957 Power Fair, engineers witness proof of...

TURBO-UNIFLO PERFORMANCE

There's no better way to judge the performance of an engine than to see it in operation. That's why more than 250 process and pipeline engineers recently gathered in Buffalo, N. Y., to attend Worthington's 1957 "Power Fair."

Star of the show was the new SUTC TURBO-UNIFLO gas engine compressor. The only two-cycle engine compressor with exhaust powered turbocharging from start-up through full-load, the TURBO-UNIFLO features remarkable stability over the complete range of speed and load requirements.

The audience was impressed by the TURBO-UNIFLO's smooth start and quiet operation (as much as 20 decibels quieter than engines with mechanically driven scavenging systems). Next came the overload demonstration to prove the very conservative engine rating.

To show stability, engine speed was gradually reduced while maintaining full torque. 320 rpm . . . 270 rpm . . . 230 rpm (at this point someone offered to bet that it couldn't go below 150). But down it went . . . all the way to 105 rpm before reaching its stalling point.

But this is only half the story. Your Worthington representative will be glad to give you all the facts about the new SUTC TURBO-UNIFLO engine. Get in touch with your nearest Worthington district office or write to Section E-73, Worthington Corporation, Harrison, N. J. In Canada: Worthington (Canada) 1955, Ltd., Brantford, Ont. E-73

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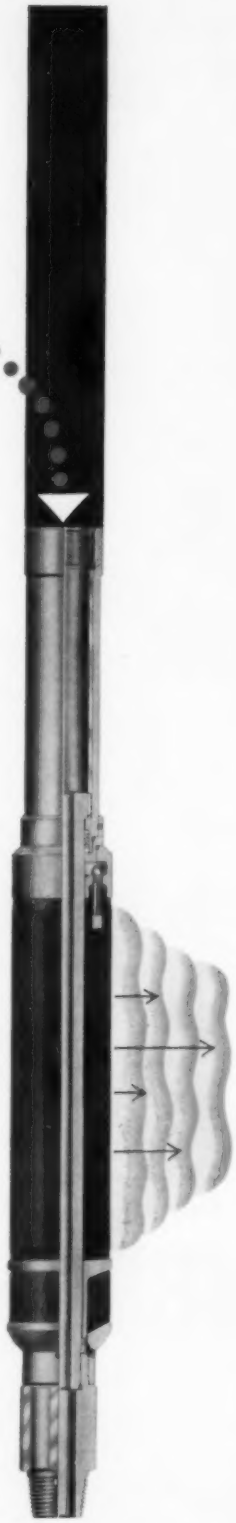
THE EXPANDING SHOE WALL PACKER ASSEMBLY



The Expanding Shoe is a hard rubber sleeve type device used below a softer rubber single end packer to help prevent the packer from extruding over the lower shoe under high temperatures and pressures. Proven highly successful and efficient in actual field operation, the Halliburton Expanding Shoe Wall Packer Assembly provides these five profitable advantages for a better test:

- **Minimized Hole Drag Through Use of Smaller Packer**
- **Easier Packer Release — Pulling or Jarring Minimized**
- **Fewer Mis-Runs**
- **More Dependability in Oversize Holes**
- **Less Rubber Left in Hole**

The Expanding Shoe Packer is just one of the effective components of the Halliburton Testing String that can be made up for application in testing your well. This smooth-working team of testing tools, ready for action by the time the drill bit is out of the hole, can give you vital information accurately, quickly and dependably.

To put the advantages of the Expanding Shoe Wall Packer Assembly and Halliburton Drill Stem Testing to your advantage, call your local Halliburton representative.

HALLIBURTON OIL WELL CEMENTING COMPANY
DUNCAN, OKLAHOMA

TESTING SERVICE

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the OIL AND GAS JOURNAL

TULSA, OKLAHOMA

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JOURNALLY SPEAKING

Button! Button!

WITH A SINGLE flip of a finger, the young man pictured here completely unbuttoned the whole Texas Eastern Transmission Corp. and thereby unwittingly demonstrated the basic problem behind all the glib talk going around these days about push-button operation of practically everything from guided missiles to hot-dog stands.

It was a dramatic moment.

The hero is Gene Kinney, one of the Journal's pipeline editors. Texas Eastern was proudly showing off one of its brand-new, automated compressor stations—completely foolproof and thoroughly decked out with every conceivable safety device and double-check instrumentation. All the company top brass was on hand—vice presidents, department heads, chief engineers, and assorted double-domed experts on electronic gadgetry.

"Now if you should want to shut down the station," they told Gene, "all you have to do is push this one little button. Suppose you just stand there as though you were going to push it, and we'll take your picture."

Gene stood. Also he pushed.

Bingo! The station shut down with a bang. Valves clashed, gears ground, bells rang, lights flashed, gas whooshed. The station was down all right. The button worked.

The company men remained calm. All such contingencies had been provided for.

"Now," said the station operator, "to start up again, all I do is push this reset button, and as soon as the vented gas clears the safety lines she'll start herself."

He pushed and waited. Nothing happened. Everybody waited. Still nothing happened. The engineers began to fidget.

"Well, back to the old drawing board," mumbled one of them, fading off to the edge of the crowd.

The electrical engineers started looking for a blown fuse. The safety engineers prepared to test for unvented waste gas. The electronics men checked the circuits. The vice presidents cleared their throats. Things were beginning to get a bit embarrassing.

Kinney: He pushed

It was one of the brass (who probably didn't know any of the details of the layout) who came to the rescue. He pushed the reset button again—hard. Everything started up again as smoothly as you please.

"Button just hadn't been pushed all the way in," he explained, dusting his hands in a self-satisfied manner.

The moral of this story is: The trouble with push-button operation is that you gotta know how to push.

Much the same conclusion (but in more erudite language) is reached in a 16-page treatise on the automatic pipeline in this issue of the Journal (page 89). It's the human factor rather than electronic wonders, the author concludes, that will determine when pipelines will become completely automated.

As to what else Gene and his colleague, veteran Paul Reed, discovered about Texas Eastern's progress in automation and other things, you can read the whole story in 2 or 3 weeks. They're now buttoning up a yarn that should really make Texas Eastern pop its buttons.

—Henry D. Ralph.

RELIABLE CONTROL

Allis-Chalmers motor control in the "Refinery of the future"

More than 125 Allis-Chalmers high voltage motor controllers provide continuity of service in Tidewater's ultra-modern refinery near Delaware City.

for continuous service

MAXIMUM round-the-clock motor protection forms a major portion of the Allis-Chalmers contribution to the world's most modern refinery. The Tidewater Oil Company selected Allis-Chalmers control to help provide the reliable, uninterrupted service needed to meet a 130,000-bbl-per-day output.

Tidewater's Delaware Refinery is another major petroleum installation depending on Allis-Chalmers control for continuous day and night operation. This growing trend reflects industry confidence in Allis-Chalmers modern controllers for petroleum requirements.

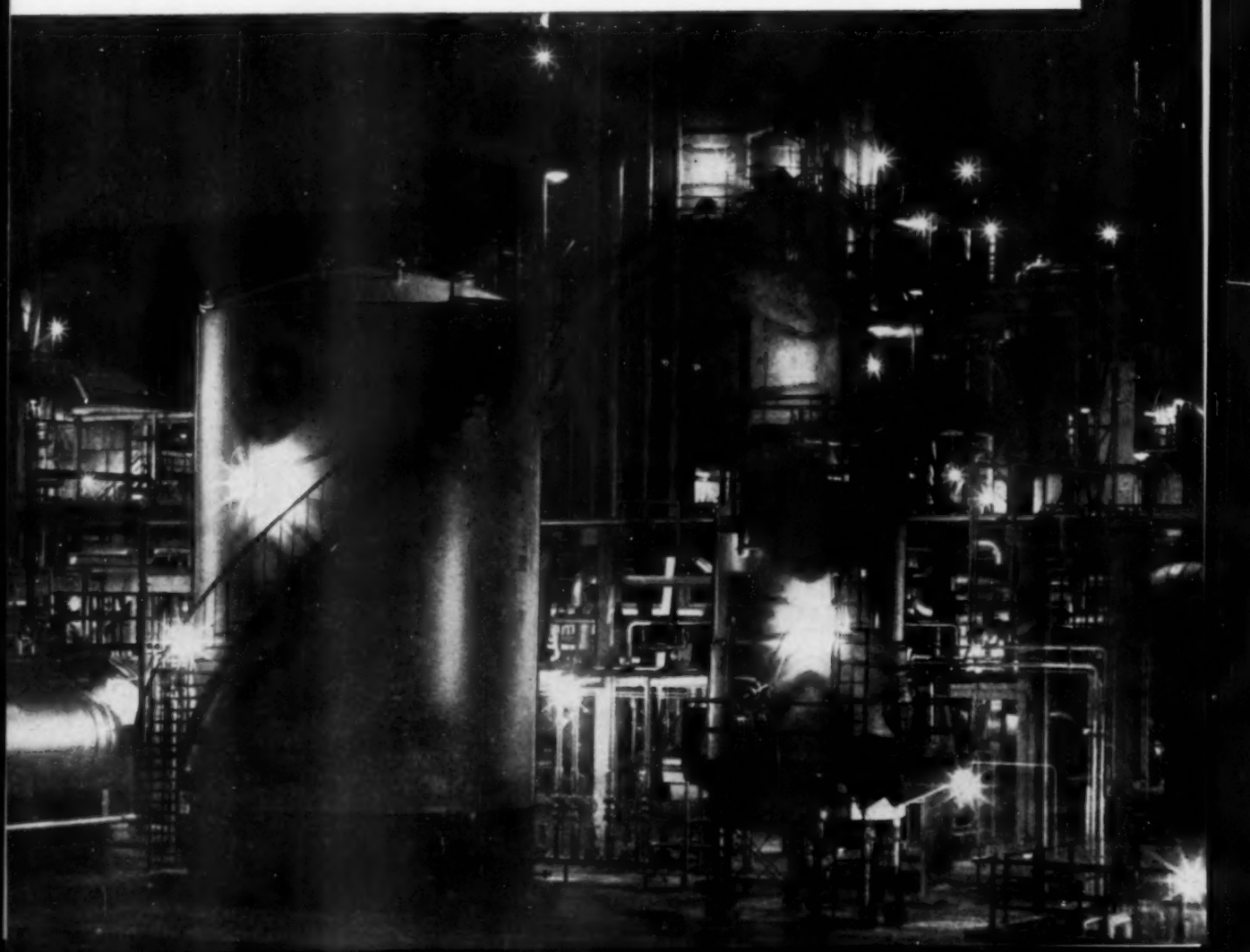
For more information about how Allis-Chalmers experience in the petroleum industry can help you, contact your nearby A-C sales office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5430

Tidewater Oil Company Refinery. This night scene shows the 130,000-bbl-per-day crude unit, where uninterrupted service is vital to successful operation.



Keep Cement
WHERE YOU WANT IT

with BAKER "METAL PETAL" BASKETS

Where a lower zone must be protected from contamination by the cement slurry (as well as from sloughings and cavings) the Baker Metal Petal Basket will be found both safe and successful.

The unit is constructed of a number of individual "petals" made of flexible sheet metal. These petals are mounted on reinforcing spring steel ribs, which in turn are mounted on a ring to form a Basket.

When running-in the hole, the upward pressure of the fluid tends to close the "petals" thus providing fluid passageway between the Basket and the walls of the hole, without distortion of the Basket. As soon as the Basket comes to rest, upward pressure by the fluid is relieved and the petals expand to contact the walls of the hole. Any tendency of fluid to move downward then presses the flexible petals more firmly against the entire circumference of the hole. Solids strained from the fluid tend to build a bridge inside the Basket which is thus converted into a one-way, open hole packer of great strength and effectiveness.

SIMPLE, EFFECTIVE ACTION

The "Metal Petals" not only expand to contact the circumference of large-diameter holes, but also pack-off in holes of irregular shape; and the independent action of the individually mounted overlapping petals permits successful use of the Basket in casing programs with minimum clearances.

All-metal construction and design provide ample strength; lessen the possibility of splitting or otherwise damaging the Basket.

Baker Metal Petal Baskets are "slidably" mounted to permit rotation, spudding, or reciprocation of the casing without distorting or damaging the Basket.

MOUNTINGS TO MEET ALL NEEDS

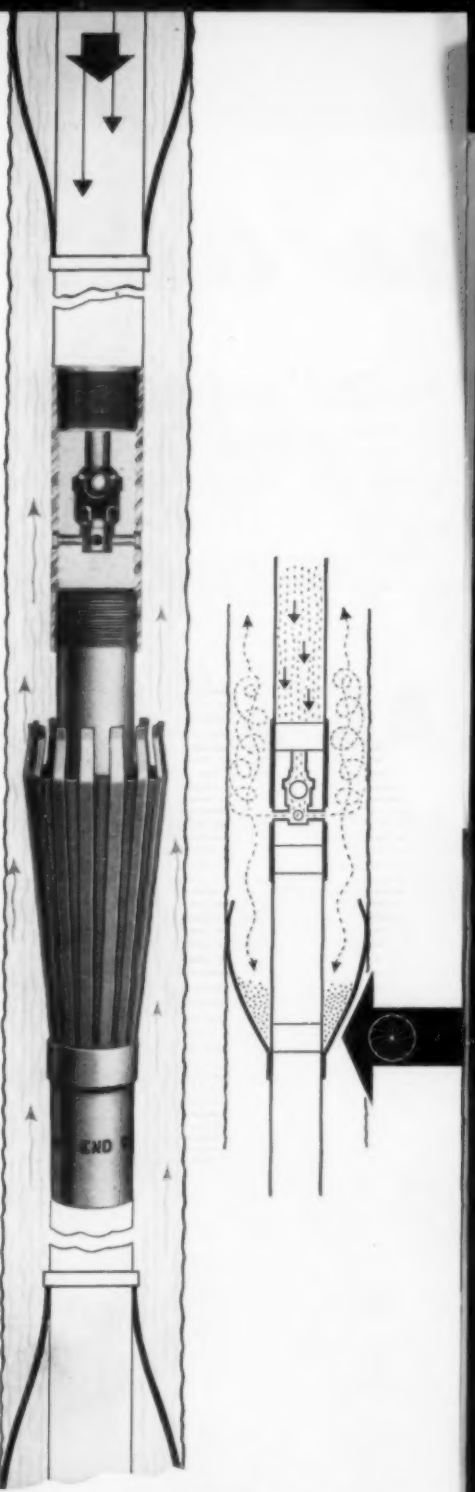
Baker Metal Petal Baskets are furnished mounted on plain or perforated nipples; with or without different types of Baker Whirler Float Collars; for a wide range of cementing applications.

Maximum efficiency of Baskets is assured when Baker Casing Centralizers are used immediately below and above the Basket Assembly.

Ask any Baker representative for specific recommendations as to how Baker Metal Petal Baskets solve specific cementing problems

BAKER OIL TOOLS, INC.
Houston • Los Angeles • New York

BAKER
"METAL PETAL"
BASKET
PRODUCT NO. 340



A popular hook-up consists of a Baker Metal Petal Basket mounted on nipple, with a Baker Cement Whirler Float Collar with Solid Baffle (Product No. 305) which whirls the cement slurry outward and upward through the baffled, side-whirler ports.

The overlapping "petals" (each mounted on its individual spring steel rib) provide flexibility and freedom of expansion to pack-off around the circumference of large-diameter holes, or holes of irregular contours.

Can oil prices buck the law of supply?

THE small advance that has been made in gasoline and distillate prices was a bold, timely, and sensible step on the part of refiners. It suggests new thinking in the industry: an attempt to recoup costs as and when they go up.

It was sensible because in these inflationary times no industry can postpone cost recovery until the verge of bankruptcy. The .2-cent advance barely covers the recent increase in refinery wages, if that. It was timely because consumers and politicians can see the immediate connection between wages and prices.

It was bold because it was done in the face of heavy oversupply. It may not be fully effective because there is so much distress material on the spot market selling below the new quotations. But it's worth the try.

CRUDE PRICES ought to go up now, too. Producers have just raised their wage scale 6 per cent and the cost of their steel supplies has gone up a minimum of 4 per cent. Since last January's price boost, crude-producing costs have increased probably 5 per cent, suggesting a 15-cent increase in crude postings.

Note that we said crude prices "ought" to go up. From the standpoint of national welfare, no prices and no wages should go up until the economy is stabilized and a halt put to the disastrous policy of letting wages and prices jack each other up every year.

But so long as the inflation spiral continues, no basic industry can buck it alone. It must recover its costs if it is to remain healthy and be able to expand and serve its customers properly. In the oil industry, at least, greater productivity and efficiency can't offset every cost jump.

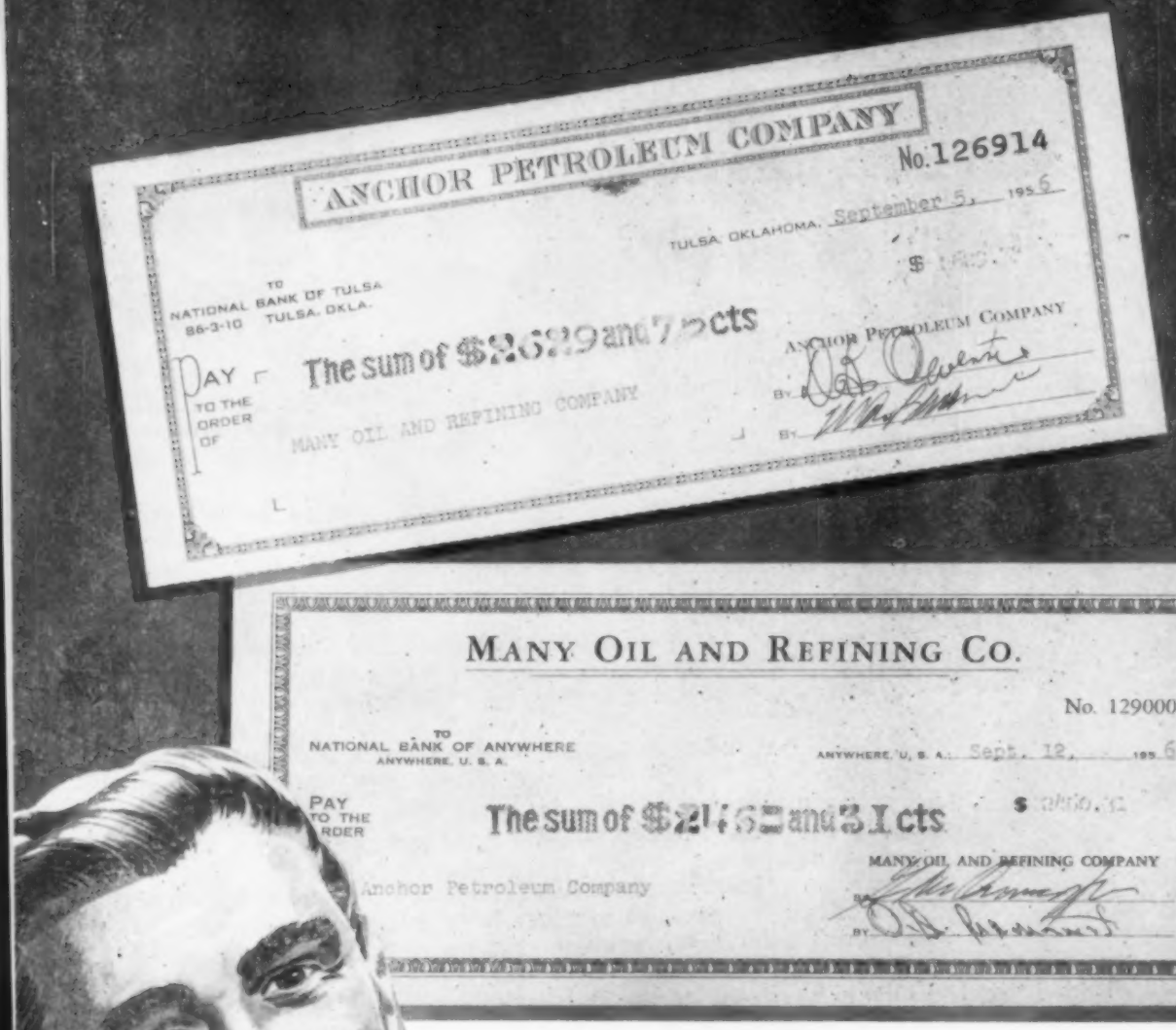
Why, many ask, can some industries—steel for example—boost prices promptly with every cost jump, while oil can't? The simple answer is that such prices are set by producers, crude prices by purchasers.

More basically to the point, the steel industry usually keeps supply pretty closely geared to demand. So when a price increase is initiated there are seldom distress surpluses on the market to keep it from being effective.

Not so with oil. Oversupply is so chronic that crude prices normally go up only on those rare occasions when there is a temporary tightness in the market.

TO RAISE CRUDE PRICES now would take a daring step by some purchaser willing to pioneer a new policy of cost-price equalization for the producing branch of the industry.

But this is most difficult in the face of the current oversupply and a weak products market. It will remain difficult until the industry stops defying the law of supply and demand by forcing unneeded oil on the market.


ANCHOR PETROLEUM COMPANY
No. 126914
TULSA, OKLAHOMA, September 5, 1956
TO NATIONAL BANK OF TULSA TULSA, OKLA. 86-3-10
PAY TO THE ORDER OF MANY OIL AND REFINING COMPANY
The sum of $2689 and 7 cts
ANCHOR PETROLEUM COMPANY
MANY OIL AND REFINING CO.
No. 129000
TO NATIONAL BANK OF ANYWHERE ANYWHERE, U. S. A.
ANYWHERE, U. S. A. Sept. 12, 1956
PAY TO THE ORDER
The sum of $2162 and 31 cts
Anchor Petroleum Company
MANY OIL AND REFINING COMPANY

Boy! They have to be nice to me!

"I'm Anchor's customer at the same time that I'm selling to them. That means that I've got a whip in each hand!

"Not that I've ever had to use it. I've been dealing with the Anchor folks for a half-dozen years or more, and they've always given me the red-carpet treatment.

"They can do it too! Their cars come to our loading racks regular as clock-work to pick up our products, and to bring us their natural gasoline.

"They've really been a big help. After our contract's made, I just set the machinery going and Anchor takes care of all the details. Gives me a lot more time to pay attention to the refinery business. Yes, sir! Now, they HAVE to be nice to me! . . . But they always were, anyway."

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the OIL AND GAS JOURNAL

July 8, 1957

Hurricane devastates coastal area at Cameron, La., where . . .

Oil Cleans Up After Audrey's Havoc

NEW ORLEANS.—The oil industry started a tremendous clean-up job last week in the Louisiana coastal area battered by Hurricane Audrey.

Company officials first returning to devastated areas found this general picture:

. . . **Offshore equipment** rode out the storm in excellent fashion. Damage to barges, tenders, rigs, and platforms was less than expected—almost negligible.

. . . **Onshore facilities** bore the brunt of the storm. Offices, warehouses, machinery, production facilities were damaged more by water from the tidal wave than by high wind.

. . . **Total damage** to the oil industry was still uncounted. Preliminary estimates ranged from about $5 million to as high as $20 million. The full cost likely never will be known.

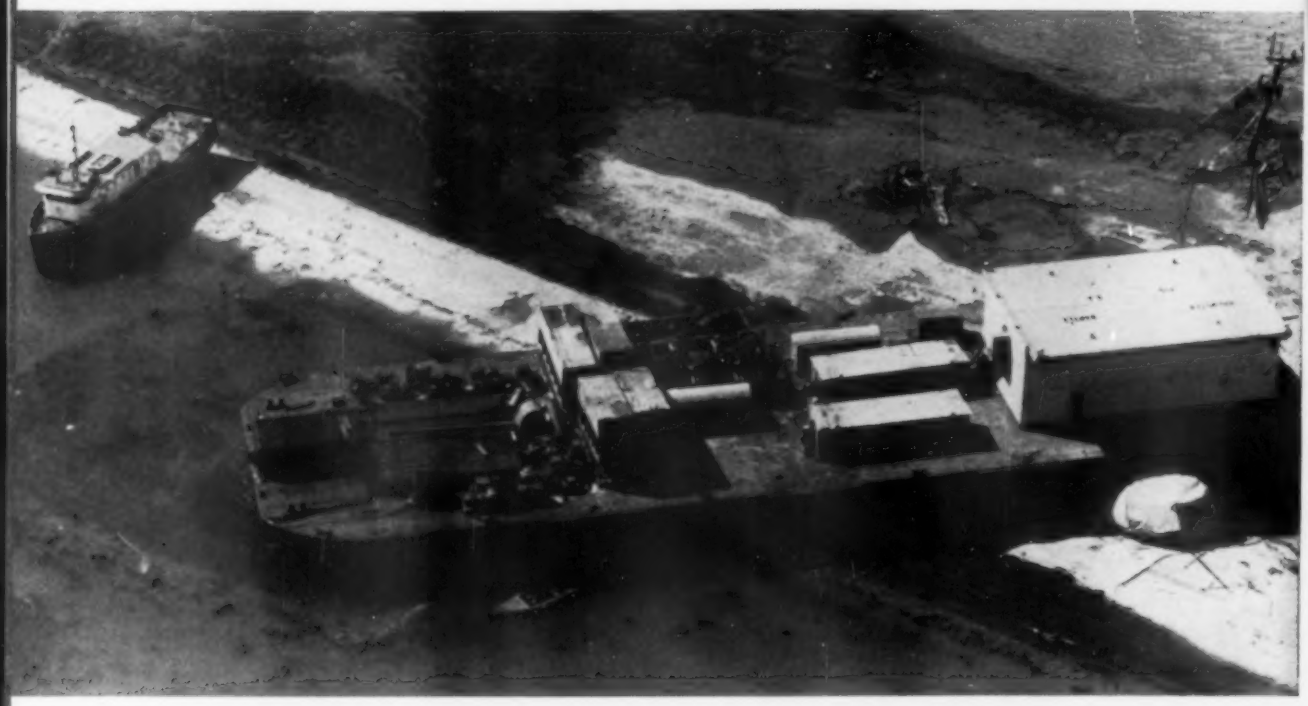
. . . **Loss of lives** was heavy—upward of 350 in Cameron area alone—but oil company personnel offshore escaped. However, many of those killed onshore were oil company employes and the effect of their loss on oil operations still can't be assessed.

Path of destruction . . . The town of Cameron, a base for offshore oil operations, bore the brunt of the hurricane.

The town was laid waste. Several nearby communities were wrecked too. They included Holly, Beach, Creole, and Grand Chenier.

The storm hit the area early Thursday morning, June 27. The havoc it wrought didn't filter through until the next day. The area was completely disorganized for several days after that. Oil company officials had trouble all last week reorganizing their operations and checking on damage. First concern of everyone was rescue and disaster work.

Most offshore facilities were evacuated before the storm struck (OGJ, July 1, p. 87). The men went home



Brewster-Bartle barge dumped across highway by tidal wave.

to care for their families ashore. No one is yet sure how many of these made it to safety or how many will return to drill again.

Industry lucky . . . The oil industry on the whole fared notably well both on and offshore.

It will be a month or more before all the reports are in. But preliminary accounts from companies show:

. . . C.A.T.C. Group. Four tenders broke away from their platforms and dragged anchor for some 40 to 50 miles before washing aground near Cameron. Two of these were owned by Reading & Bates Drilling Co., doing contract work for the group.

The Reading & Bates tenders were towed back to location and immediately resumed drilling operations. One of the C.A.T.C. vessels also was towed back but the other was towed to drydock at Orange. Operators said it was scheduled for repairs later this summer anyway. Only major damage to it from the storm was salt-water damage to crew living quarters.

Inspection of fixed drilling platforms served by the tenders showed twisted walkways and handrails, but the structures were in good shape.

. . . Superior Oil Co. Two self-contained platforms were damaged. Piling of one were bent about 8 degrees from vertical. All equipment will be moved off to allow repairs to be made. The other platform will require only minor repairs.

Company facilities at Cameron including houses and a dock were wrecked. Two producing platforms off Creole also were severely damaged. Wellheads were not bothered, but topside equipment was wiped

Storm tosses oil-barge tow across Intracoastal Canal.

Oil crewboats rescue storm survivors.

clean. A Superior tank farm near Creole escaped with only one house reported damaged.

... Marine Gathering Co. The company's big gas-separation plant and dehydration station near Cameron weathered the storm. The plant serves Pure Oil Co. and Phillips Petroleum Co. wells in Rollover field. It is protected by a levee which withstood flooding from the huge tidal wave following the hurricane.

The plant was shut down prior to the storm but was to be reopened as soon as Pure and Phillips can restore their platforms to production. The platforms were prepared for the blow. All loose gear was secured before the storm and crews evacuated. An aerial inspection showed them to be in good condition.

... Mecom's rig. Biggest equipment casualty was a mobile drilling platform, the Ed Malloy, owned by the John Mecom interests of Houston. Six crewmen left aboard the rig took to life rafts (see photo) and were rescued by plane the next day.

The Malloy was designed similar to a floating drydock with the dock submerged on location and a drilling-barge section supported by cribbing above the water.

Here's what happened. The cribbing gave way and the barge settled horizontally on one end of the dock. The wing of the drydock was knocked off, but the remainder was intact. Divers are inspecting the platform to estimate the salvage possibilities of the $1½-2 million structure.

... Mr. Gus. This famed offshore mobile drilling platform of Glasscock Drilling Co., an earlier victim of a gulf storm, got a backhanded assist from Audrey.

Mr. Gus had been tilted on one side and was undergoing salvage work to right it. Salvage crews abandoned work when the hurricane approached. The high wind and waves of Audrey flopped the big structure back into an upright position.

... Humble Oil & Refining Co. A barge blown loose by the storm struck Humble's Goodrich No. 6 at Weeks Island, causing it to blow wild. A flanged connection with a new valve was attached, and the well was shut in 2 days later.

Several wells were reported out of control in the Cameron area immediately after the storm and tidal wave. But air observers later reported the wells apparently were sanding up and losing their punch. Some broken flow lines also were reported.

A fixed platform 11 miles off Galveston played a part in the first tragedy of the storm. The fishing boat Keturah with nine aboard, was being towed by a Coast Guard cutter. The towline broke, and the ship tried to make it ashore under auxiliary power when it struck the platform and sank with all hands.

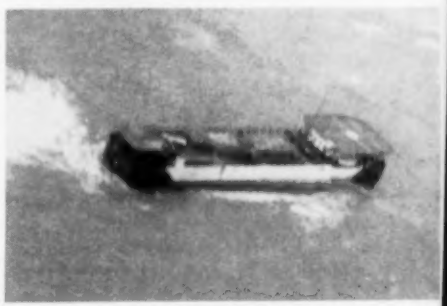
... Brewster-Bartle Drilling Co. A tidal wave beached a barge towing part

At Height of Storm...

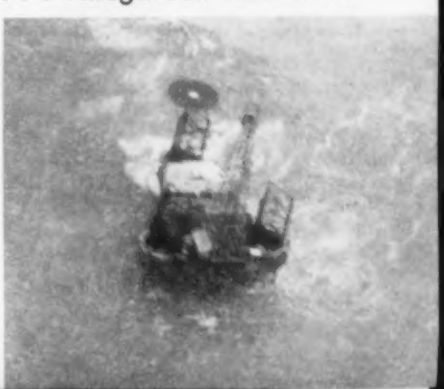
. . . Rig crewmen adrift

. . . Tanks toppled, marooned

. . . Tender goes aground



. . . Vinegaroon rides it out



of equipment from Brewster-Bartle's Rig 3-A. The barge was lifted out of the Intracoastal Canal and deposited crosswise over the highway into Cameron (photo.)

. . . Zapata Offshore Co. The Vinegaroon, Zapata's new tripod drilling platform rode out the full fury of the storm and came out practically unscathed. The rig was operating in West Cameron Block 67. On July 2 it resumed drilling.

. . . Offshore Co. of Baton Rouge. The company's mobile platform operating in 103-ft. water off Vermilion suffered minor damages. The foundation settled causing the platform to list and put the jacks in a bind. The rig was later righted and resumed drilling.

. . . Richardson & Bass. A derrick blew down at an inland location. Another rig stacked near Cameron was flooded and will require cleanup work.

. . . Southeastern Drilling Co. Two rigs running in the Morgan City area sustained damage to ladders and catwalks below deck level from waves 35 ft. high. Two submersible drilling barges for use in coastal and inland waters were sunk by the tidal wave. Both have been raised and put back into workable condition. Engines, pump-drive chains and power equipment for pumps were taken apart and cleaned.

. . . Magnolia Petroleum Co. Most damage to producing and drilling facilities was minor. Some landing platforms on production platforms were swept away. So were dolphins, the protective pilings driven outside the platform to protect them from damage by boat bumping. Some coastal gas-separator installations and the Magnolia office in Cameron were damaged.

. . . Pan American Petroleum Corp. Big job is getting production back after being shut in for storm. Pan American has substantial production between Grand Chenier and High Island. No wells were lost in the storm, but the company hasn't had time yet to assess full damage to separators, tank batteries, flow lines, etc.

Refineries escape . . . The big refineries and petrochemical plants in the Lake Charles, Port Arthur, and Orange areas fared remarkably well.

Continental Oil Co. reported two partially completed coke silos for a new coking plant at its Lake Charles plant were knocked down with minor damage. The plant shut down for 26 hours with a loss of 56,850 bbl. in crude runs.

Nearby, the larger Cities Service Refining Corp. plant remained onstream as did the Cit-con Oil Corp. lube-oil plant. A Cities Service spokesman said only minor damage was experienced. He said reports indicated winds of only 65 miles an hour would hit the refinery.

Since the plant was designed to withstand 100-mile wind, it was decided to keep operating. But when the storm hit, winds up to 105 miles an hour were experienced. "If we had expected 100-mile winds, we would have shut down," he said.

At Port Arthur, Gulf Oil Corp. closed down its mammoth refinery. The Texas Co. plant nearby stayed on stream during the storm. Damage at both plants was confined to broken telephone lines and light shacks. Levees prevented flooding.

Rescue operations . . . Oil companies threw their resources into the rescue operations following the storm.

Helicopters, float planes, crew boats, marsh buggies all operated to take survivors to rescue centers. Oil tenders hauled large numbers of dazed victims to Lake Charles.

The Cameron area was declared uninhabitable for about 3 weeks because of the threat to life from indescribable conditions there. This will delay oil officials from evaluating the full damage to their property and getting facilities back into operation.

But as one company official remarked after returning from the devastated area: "The human misery there is indescribable. And from the industry standpoint, with so many million dollars worth of equipment strung out on and offshore, it's amazing we came out so lucky."

Core drills probe tar sands as . . .

. . . Sohio Tests Asphalt Ridge

VERNAL, Utah.—Another big tar-sand project may be in the making. And if it pans out, it may spawn some new twists in recovery and processing.

The prospect is a 15-mile northwest-southeast stretch of oily sand called Asphalt Ridge, a bituminous outcropping south and west of this Uintah County community in the northeast corner of Utah.

Sohio Petroleum Co., wholly owned subsidiary of Standard Oil Co. (Ohio), is evaluating the ridge and will develop it if tests indicate the sands will give up commercial quantities of crude.

The company has a temporary lab set up in Vernal and two core-drilling rigs on the job.

Sohio figures it will take about a year to find out whether it will go ahead with development. And it isn't saying much about its plans in the meantime. But riding on the answers the lab men come up with are:

. . . An estimated investment of $30 to $40 million.

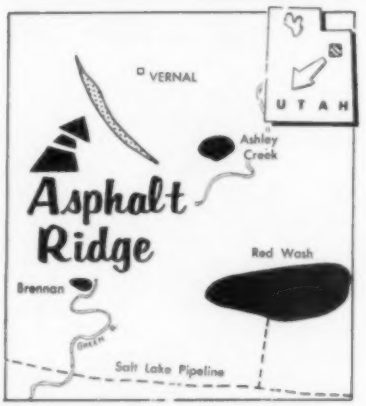
. . . A new pipeline.

. . . A field processing plant.

A catalytic cracking plant, probably at Salt Lake City, is also a possibility.

The sands . . . Asphalt Ridge is believed to be the largest oil-saturated sand bed in the United States. The bitumen is similar to that of the big Athabasca tar-sands country of Canada except that the Utah deposits are sulfur free.

In some locations already core drilled, the sands are over 100 ft. thick, with oil content averaging about



a barrel per cubic yard of sand. The overburden varies from a few feet to several hundred. In some areas the sands outcrop on the surface.

Oil men—and other investors—have been taking periodic and close looks at the outcropping of oil-saturated sands for over 70 years.

The sands have been used extensively as a paving material for Vernal area roads and sidewalks, but that's about as close to commercial development as they ever got, despite the fact that a number of small-scale attempts have been made in that direction.

Original claims were filed on Asphalt Ridge in the 1800's. The latest attempt to turn the sands into a commercial product came from Ridge Development Corp., a jointly owned subsidiary of the W. M. Barnes Co. and Knickerbocker Investing Corp.

Barnes leased the properties in 1951 and developed a process to separate

the oil. Knickerbocker then joined the project and part of the ridge was core drilled. They sold title to the lands to Sohio late last year, but will be cut in on profits if the area is developed.

The process . . . If reserves prove out, Sohio reportedly will use open-pit mining in the section which outcrops above the ground. In situ combustion is being considered for bringing up the deeper-placed bitumen.

Combined mechanical and heat methods would be used to separate oil from the pit-mined sands. The resulting product, a sand-free pitch of 8° to 9° gravity, would be converted to a low-pour-point catalytic cracking stock of 28° to 30° gravity through visbreaking.

After this retorting process, the crude would be ready for shipment by pipeline to refining centers. Sohio says it will take "10 to 25 thousand" barrels a day to make the project economically feasible.

Anderson Affirmed

New treasurer once spoke out for present depletion

WASHINGTON.—Oil man Robert B. Anderson will be the next Secretary of the Treasury. This was made official last week when the Senate, without a dissenting vote, confirmed his appointment on the advice of its finance committee.

Anderson is expected to take over his new office within the next few weeks when present Secretary George M. Humphrey leaves the cabinet after more than 4 years of service. The new treasury head was formerly manager of the W. T. Waggoner estate, and from 1953 to 1955 served as Secretary of the Navy and later as Deputy Secretary of Defense. Since leaving the government service he has been president of Ventures, Ltd., of Toronto.

Anderson won the unanimous approval of the finance committee late last month.

The former Defense Department official told the committe that he would approach the question of depletion "objectively." But he pointed out that before he joined the Government he had testified in favor of the oil and gas industry's present allowance.

Anderson made public his stock holdings at the request of Sen. Albert Gore of Tennessee. He said he holds 2,000 shares of Dresser Industries stock, 14,701 shares of Webb & Knapp, Ltd., of Canada, 1,250 shares of General Carbon & Chemical Corp., and 172 of the Great Southwest Corp.

watching WASHINGTON

. . . with Bertram F. Linz

Where Kuykendall stands . . .

JEROME K. KUYKENDALL will learn in a few days whether he is to go back to work as a member of the Federal Power Commission.

Right now, he's out of a job. His term on the FPC expired June 22. And since Congress is in session he must be confirmed by the Senate before he can take office again.

So far, none of President Eisenhower's nominations has been rejected. Kuykendall may not be the first to be turned down—but he could be.

The Senate commerce committee held a 5-day hearing at which a dozen witnesses opposed the nomination and no one except Kuykendall appeared in his behalf.

Kuykendall told the committee he was working for consumers when he tried to write a new gas bill last year under orders from the White House. And he asserted he has "conscientiously" enforced natural-gas regulation, although he doesn't like the Phillips decision.

The big issue is not gas but public power. The FPC has opposed it. But Senate Republicans took a bad beating recently in a vote on the Hells Canyon dam. That, plus the unfriendly attitude of Senator Magnuson, committee chairman from Kuykendall's own state, and the lack of Republican support at the hearings, has raised speculation that the administration may not fight for his reappointment.

Shale fuss irks Congress . . .

CONGRESS is a little peeved about the squabbling between Interior and the Navy over oil-from-shale research. So it's hoping to do something to settle the row, once and for all.

Both departments want the Rifle, Colo., research plant. Both want to set up a new, big research program. But neither has come up with a detailed plan with which to coax money from Congress. On top of that, they have been rowing over who is to pay the cost of keeping the plant in standby until the feud is settled.

Uncertain as to who was going to do that, Congress has refused to give either department maintenance money. The House aimed at settling the fuss by ordering the orphaned plant sold, leased, or transferred for other government use elsewhere, but the Senate wouldn't go along.

Debate over the plant disclosed that the researchers themselves differed on the results of 10 years of effort to make oil from shale. Some held that the work at Rifle was years ahead of the results in the Bureau of Mines itself. Bureau experts claimed they were 10 years ahead of Rifle.

The research project was closed down 3 years ago. Since then the plant has been transferred by Interior to Navy and back again. And unless something is done soon the plant will deteriorate.

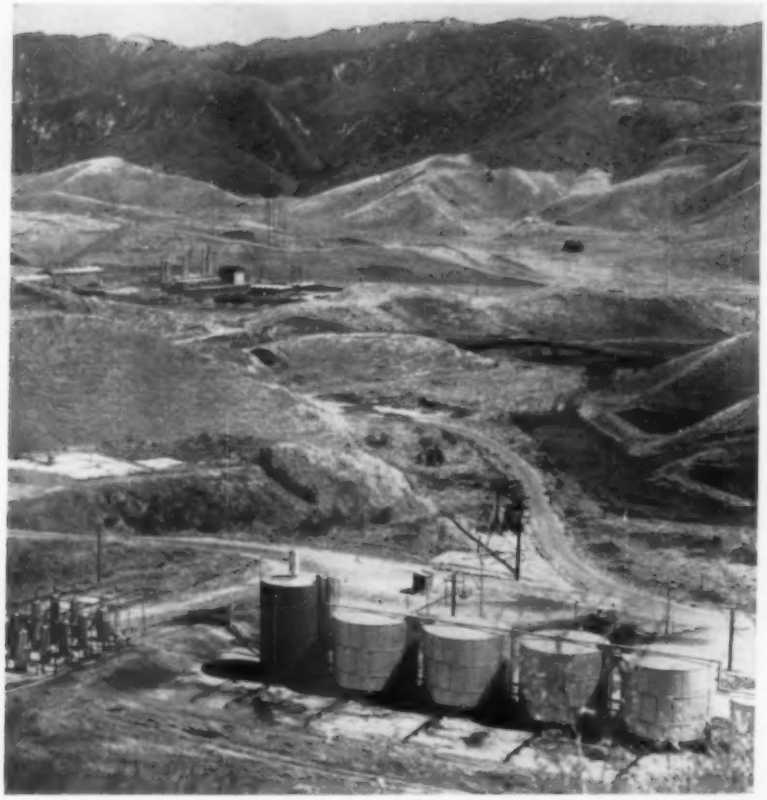
Rubber on West Coast . . .

THE synthetic-rubber industry has shown no signs of monopoly since it was transferred from the Government to private owners.

But in a report on the industry after its first full year in private hands, Atty. Gen. Herbert Brownell, Jr., told Congress that the rubber manufacturers show evidence of "an incomplete development of competition."

Brownell's report sums up a survey of the industry which Congress ordered him to make yearly. The purpose is to see that the former government-owned plants aren't being used monopolistically.

New rubber producers are having no trouble getting into the industry, Brownell found. But he admitted concern about the West Coast, where Shell Chemical Co. is the only producer. With little competition, rubber consumers there are limited in their choice of suppliers. That, apparently, is an area on which the Justice Department will keep a constant watch.



SUNRAY MID-CONTINENT is trying something new in Newhall-Potrero field.

L.P.G. Flood Combined with Storage in California Project

LOS ANGELES.—Sunray Mid-Continent Oil Co. is experimenting with the nation's first combination L.P.G. storage and secondary-recovery project.

The company is using the upper Miocene zone in Newhall - Potrero field just north of here to test the double-barrel possibilities of miscible-phase displacement.

If it works, Sunray will be killing two birds with one stone. The company hopes to:

. . . **Double ultimate recovery** of oil from upper Miocene pay.

. . . **Store propane** during slack summer months when the bottom drops out of the propane market. In winter, when demand doubles, the propane will be backflowed through the injection well and sold.

Other companies have already carried the miscible-phase principle of secondary recovery from the lab to the field, and are now spending millions of dollars on the newly developed method (see related story on page 76).

Their objective is to sweep the reservoir with a solvent that is miscible with crude. But Sunray's California project is the first time that L.P.G. storage is one of the objectives—although a secondary one.

Sunray is confident that the propane will increase ultimate recovery, but the company's not sure it will pay to store L.P.G. in a sand highly saturated with oil.

Gas and water sands are the best for storage of L.P.G. In a highly oil-saturated zone, there is a danger of contaminating the propane. When this happens, it requires additional expense for processing before the propane can be sold.

Sunray's pilot . . . Sunray's project is limited to only one of seven zones in the 1,200 - acre Newhall - Potrero field—the upper Miocene found at approximately 6,500 ft.

The pilot is controlled through two wells: One for injection of propane, and the other for production of oil.

Since the beginning of the program in mid-June, the company has been injecting an average of 400 bbl. of propane daily. The producing well is being produced at 200 bbl. of oil daily.

If the project pans out, the operator intends to produce the test zone from a half dozen other wells.

The reservoir is actually only a small part of Newhall-Potrero, with an estimated 1,000,000 bbl. of oil in place originally. Of this, 250,000 bbl. has been produced. Sunray figured it could push ultimate recovery to 320,-000 bbl. by using water or gas drive. With propane, the outlook is a much brighter 650,000 bbl.

This is only 65 per cent of the oil in place. Other operators have estimated that miscible - phase displacement could mean a recovery of as high as 85 to 90 per cent of the oil in place. But Sunray engineers feel that the upper Miocene's slight gas cap will hold ultimate recovery down to a conservative 65 per cent.

Pool's history . . . Sunray owns 145 of the pool's 156 wells. The deepest producing zone is below 12,000 ft., although earlier production was as deep as 14,000 ft.

The pool was discovered in 1937. As of January 1, cumulative production was 42,556,000 bbl., which indicates the relatively small area involved in the pilot. Reserves remaining in all zones were estimated at 37,-444,000 bbl. January 1.

All zones—with the exception of the upper Miocene—are pressurized with dry gas from Sunray's natural-gasoline plant in the field. The plant has a capacity of 46,600 M.c.f. daily, and turns out 700 bbl. of propane daily, with butane and natural gasoline.

The upper Miocene was known to be productive for many years, but Sunray didn't tap it until last August. A deep producer was plugged back and the well came in for 200 bbl. daily.

Bottom-hole pressure decreased rapidly after completion in the tight sand, so production was shut in while the company studied the possibility of combining an L.P.G. storage and miscible-phase displacement project.

The zone is 50 to 60 ft. thick in some places. There's a water contact on three sides of the elongated field, and the sand pinches out on the nose of the anticline. The sand is not highly permeable.

Sunray found the sand ideal for its limited experiment. Propane is injected at 1,400 psi. Reservoir pressure

is now 2,500 psi. Bottom-hole flowing pressure is 1,500 psi.

Propane withdrawal . . . Sunray may try its first withdrawal of propane next winter. The propane will be taken out of storage during heavy-demand season by backflowing the input.

If the storage is too highly saturated with oil, and withdrawal is economically impractical, then Sunray will chase the rest of the propane through the producing zone with dry gas to speed up recovery. In this case, the storage aspect of the project will presumably be abandoned.

But whatever the outcome, Sunray can't lose much, because the stored propane, already injected, will help boost the ultimate recovery.

More Gas to Go West

● New firm organized by Warren, Monterey, and Butler will build gas pipeline from Four Corners to California

LOS ANGELES.—A company has been formed to build a gas line to the growing California market, a market that has been sewed up by El Paso Natural Gas Co. for several years. The new line would run from the Four Corners area.

The new company—Trans-Western Pipe Line Co.—was organized by Warren Petroleum Corp., Monterey Oil Co., and J. B. Butler, Houston consulting engineer. Each holds one-third interest in the company.

John R. McMillan, executive vice president of Monterey, is president of Trans-Western. R. C. Frederick, formerly with Pacific Northwest Pipeline Corp. and now gas coordinator with Gulf Oil Corp., Warren's parent company, is vice president.

McMillan said Trans-Western is shooting for 2 trillion cubic feet in reserves and an initial volume of 200,000,000 cu. ft. per day. Some reserves have been signed up in the Colorado, New Mexico, Arizona, and Utah area. But McMillan estimated the project is about a year away from construction.

Unique aspects . . . Trans-Western plans to enter the market now served entirely by El Paso Natural. The company will become a competitor for gas reserves in the Paradox and San Juan basins which now are largely controlled by El Paso and its subsidiary, Pacific Northwest.

Trans-Western's venture also is the first instance of major oil companies entering the gas-transmission business. They have heretofore shied away from interstate gas pipelining because of its limited return of 6 per cent and stringent regulation by the Federal Power Commission.

Reason for line . . . Why is this group entering a business which has been unappealing to oil companies in the past?

"It looks like a money-making venture," McMillan said, "and we're always interested in making money."

There is also the angle of providing a ready outlet for potential gas acreage held in the Four Corners area by Gulf and its affiliates. But Trans-Western also is bidding against El Paso for reserves to firm up the line. The company first approached producers in Aneth field in the Paradox basin but was unable to find reserves in sufficient quantity. Attention was next focused on the San Juan basin and elsewhere in the Rocky Mountain area.

El Paso and Trans-Western both have talked to producers in Bisti field of northwestern New Mexico about contracts for their oil-well gas. El Paso has made firm offers for about 14 cents an M.c.f.

Destination of gas . . . It hasn't been disclosed who will buy the gas, if and when the line is built, but there are three possibilities:

. . . Southern California Gas Co. and Southern Counties Gas Co., which serve Los Angeles.

. . . Pacific Gas & Electric Co., which serves San Francisco and the northern California market. P.G.&E. and the Los Angeles utilities buy all their out-of-state gas from El Paso at the Arizona-California border.

. . . An industrial consumer, which would purchase gas direct without going through a utility.

The Los Angeles and San Francisco companies said they hadn't been contacted by Trans-Western. Both have been aware of efforts to put the project together, however, and indicated their interest in a new supply source if it becomes available.

Should the sale be made directly to an industrial plant, it would involve building a line from the California border, where Trans-Western plans to stop, to the plant. Precedent for such a sale is the deal of Houston Texas Gas & Oil Corp., which is building a line from Baton Rouge to Miami, with two Florida power companies. The FPC regulates only the transportation charge and not the price of gas, which is very attractive to producers and to a pipeline seeking a minimum of government control.

Producers, in this case, sell directly to the consumer, and the pipeline never actually owns the gas.

JOHN R. McMILLAN
. . . Trans-Western's president

R. C. FREDERICK
. . . vice president of the new firm

Parks Propane Flood Gets Fast Start

● Industry watches as nation's biggest miscible-phase displacement project is launched. Magnolia is banking on ultimate recovery of 30,000,000 to 40,000,000 bbl.

MIDLAND, Tex.—The biggest miscible-phase displacement project yet, a huge $3,500,000 operation, is under way.

Magnolia Petroleum Co., as unit operator, has started injecting propane through half a dozen of the planned 25 input wells scattered over the big 8,160-acre Parks Pennsylvanian unit.

Injection began shortly after the Texas Railroad Commission approved the program and related special field rules in June, following a hearing in May (OGJ, June 3, p. 64).

Magnolia counts on having full-scale propane injection going in the next week or two.

The unit will use a propane slug chased by gas, one of three variations of the red-hot miscible displacement principle (OGJ, Mar. 11, 6. 96).

All told, it will force a staggering 1,500,000 bbl. or more of propane into the 10,400-ft. Bend section of the Pennsylvanian within the next 9 months to a year. Daily input rate will be about 6,000 bbl.

Then the unit will switch over to gas as the sweeping force and inject roughly 16,000,000 cu. ft. daily through the same inputs.

Magnolia thinks the program will lengthen field life from 6½ years to about 12 years and hike oil recovery from 100 to 150 per cent of primary production.

Primary from the pay has been estimated by Magnolia at about 15,000,000 bbl. The miscible drive thus would kick up total ultimate oil take to between 30,000,000 and 40,000,000 bbl.

The unit feels that the propane-gas drive will recover much more oil in Parks than a water flood. In fact, the unit is taking the miscible route rather than expand a highly satisfactory pilot flood already in operation.

Not only will the unit recover more oil, but it hopes to get back 90 per cent of the propane injected.

Unit moving fast . . . Magnolia is off to an extremely fast start.

The company had negotiated provisional contracts for propane and gas supplies prior to the hearing on the Parks project. It also had made tentative arrangements for compressor and pumping equipment and talked with contractors about laying the necessary supply and distribution lines.

So it was ready to go when and if the commission gave the word.

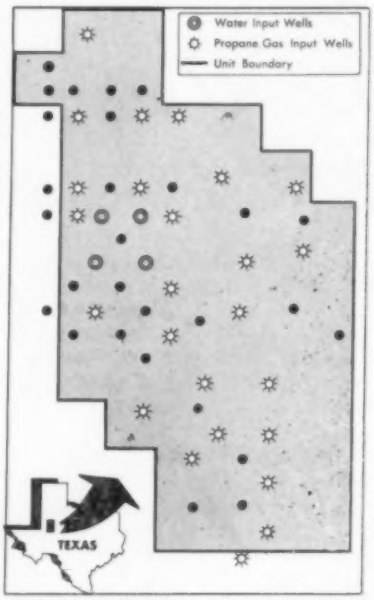
The unit operator already has installed the needed propane pumps and gas compressors in an existing compressor station in Parks.

A network of small propane distribution lines connecting the plant and input wells is nearly completed.

Magnolia will get about 2,000-bbl. daily of the needed propane from the gasoline plant it operates in Pegasus field a few miles to the south on the Midland-Upton county line. It will pipe this to Parks through an existing 4-in. line.

It has bought the other 4,000 bbl. daily of needed supply (a contract total of 800,000 bbl.) from El Paso Natural Gas Co. El Paso will make this volume available to Magnolia at the former's big Midkiff natural-gasoline plant in Spraberry Trend Area field about 20 miles east of Parks. Magnolia is laying another 4-in. line from Parks to pick up the Midkiff product and likely will complete it this week.

Natural gas will come from Parks itself and other sources not disclosed.



FULL-SCALE injection of propane through 25 input wells will begin soon in Parks field, Midland County, Texas. The input well south of the unit has not yet been converted to injection service, but Magnolia plans to eventually extend the project southward. Miscible-phase displacement looks so promising at Parks that the highly satisfactory five-spot pilot flood already in operation is being shelved.

Reason for haste . . . Much of the haste is due to rapidly dropping pressure in the field.

Magnolia urged the Railroad Commission to act quickly at the May hearing on the project, otherwise field pressure might drop too low to insure miscibility and wreck the whole plan.

Parks is a relatively young field. But like many other West Texas pools it produces naturally under an inefficient solution-gas drive.

Magnolia discovered the field in December 1950 and is the biggest operator, with a unit working interest of over 90 per cent. Discovery pressure was 4,567 psi. By last January this had fallen to 1,710 psi.—a drop of more than 2,800 psi.

The original gas-oil ratio of 1,770:1 had scooted up to an average 6,250:1 in January. Burdened with such a high ratio, Parks' 55 producing wells have had production cut sharply under ratio penalties enforced by the commission.

Production falls . . . From a production highpoint in September 1952 when only 29 wells produced an average of 2,662 bbl. of oil and 11,044 M.c.f. of gas daily, the field has slumped to a daily output in March this year from the 55 wells of only 985 bbl. of oil and 9,537 M.c.f. of gas a day.

It became obvious early in the game to Magnolia and the other operators in Parks that the natural drive would be poor. This has slowed field development. About 10,000 acres in the field are considered reasonably proved. But only about 4,720 acres are fully developed. There's room for about twice as many wells on the field's 80-acre spacing pattern as are now producing there.

The field was unitized in July 1954. And the pilot water-flood was launched the following February. Since then more than 1,700,000 bbl. of water has been injected in a single five-spot on the west side of the unit.

The allowable of the center producer in the five-spot climbed 377 per cent from 58 to 210 bbl. daily; the throttling G.O.R. was cut from 7,910:1 to only 1,336:1; and pressure hiked up to 2,974 psi. from 2,159 psi.

Results in a 10-well observation area have been good too, though not quite so spectacular.

The unit hasn't yet finally decided to abandon the water pilot. The present plan is to block it off temporarily.

Eyes on project . . . The industry will watch the Parks operation closely, for it should go a long way toward helping settle arguments as to whether the propane-slug technique is economically sound.

It not only is the largest miscible-phase project yet attempted but is also the only large field-wide test of the propane slug method.

There are some operators who think a miscible plan can't stack up economically with a water flood. Some fear that the propane-gas drive, because of poor mobility ratio will not sweep large areas of a reservoir, resulting in little or no better recovery than from a flood. Magnolia, however, think differently—and it's laying a lot of money on the line in Parks to prove it.

Pescadito test looks good as . . .

Huge Salt Dome Yields Gas

LAREDO. — South Texas' biggest exploration news—the Pescadito dome —is getting hotter.

Ginther, Warren & Ginther's wildcat on the structure had a big gas flow on a test last week. The well made headlines 2 weeks ago when it proved the existence of the deep salt dome (OGJ, June 24, p. 105).

Indicated producing horizon is the Georgetown lime. The test lasted only 20 minutes before a joint of drill pipe collapsed. During that 20 minutes, the well flowed gas with a tubinghead pressure of 2,400 psi. against a ⅜-in. choke. There was no measure of the volume nor of the fluids content.

The hole will be resumed just as soon as the operator can condition the mud, get the pipe out, and get another packer back in the hole.

Before the test, the well had been treated with 8,000 gal. of acid. It may be necessary to reacidize, since mud stood against the formation after the drill pipe collapsed. The test was from open hole between the bottom of 7-in. liner at 12,898 ft. and a cement plug with top at 14,150 ft. The liner was made up of 2,063 ft. of 26-lb.-per-ft. 7-in. pipe hung at 10,835 ft.

Top of the Georgetown had been logged at 12,900 ft.; it extended down to 14,396 ft. where the well drilled the caprock on the salt dome. During drilling, mud log showed gas, apparently in fractures, throughout the section. The structure covers some 30,000 acres, and Ginther, Warren & Ginther holds a major part of that. Location of the well, the 1 Killam, is close to the center of the structure.

Temperature no problem . . . On the last electric log two thermometers showed temperatures close to 450° F. When pulled, both these thermometers were still in good condition, as were their cases. For that reason, Ginther, Warren & Ginther took average of the two readings—450° F.—as correct temperature at log depth of 14,552 ft.

The company had expected to drill as deep as 17,000 ft. to find the main objective, the Edwards. Previous wells on the Pescadito structure logged high temperature gradients and it appeared that bottom-hole temperature of the 1 Killam might reach 500° F. if it found the Edwards. Previously, Magnolia Petroleum Co. chalked up the highest temperature ever drilled—in West Ranch, Texas, field in 1955. There temperature reached 389° F.

Lime-treated muds common to South Texas drilling cannot be depended on to withstand temperatures much above 300° F. So, Ginther, Warren & Ginther decided to use a low-sodium surfactant mud.

The surfactant mud was put in the hole after intermediate casing was set about 11,000 ft. Hole was drilled to total depth with no trouble at all. This is the more remarkable since the mud was cut by gas, contaminated by salt-water flow, and contaminated by drilling on cement.

While many specialty muds are extremely expensive, the low-sodium surfactant mud costs little, if any, more than a lime-treated mud of the same weight.

Even at total depth, flow-line temperatures were not too high (170° to 180° F.). This led to some speculation that the temperature gradient is not uniform at the bottom of the hole, that the temperature takes a bigger drop just above the salt than it does elsewhere in the hole. The idea is that the salt mass itself, a good heat conductor, is an island of heat surrounded by cooler rocks.

—— *Industry* briefs

Zapata Off-Shore Co. claims a new speed record in relocating a mobile drilling platform in the Gulf of Mexico. Its three-legged platform, the "Scorpion," reportedly was lowered to floating position, towed about 1 mile, and set up on a new location, all within 8½ hours.

The move occurred about 10 miles out from the South Pass of the Mississippi River, in water about 60 ft. deep.

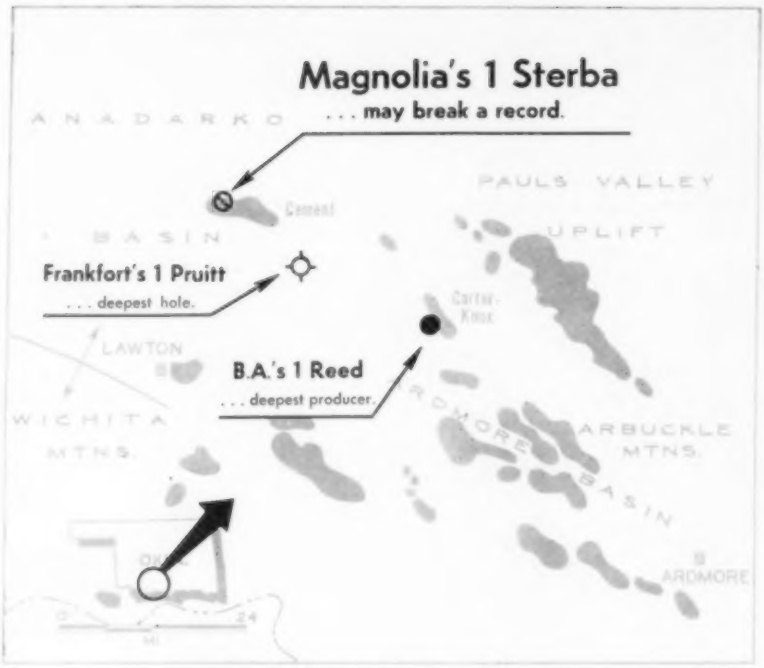
Producing Properties, Inc., Dallas, has added 1,800,000 bbl. of oil to its reserves with the purchase of 12 wells in the lush "fairway" of East Texas field. Purchase involves a $1,500,000 deal with National Oil & Grease Co., Penworth Oil Producing Co., and Mrs. Sara R. Hulsey. Producing Properties, Inc., will pay the three parties $600,000 in cash, and $900,000 in payments from production.

Operating interest in a 2,555-acre block in East Nowata field of Nowata County, Oklahoma, has been purchased by Slick Secondary Recovery Corp. of San Antonio. There are 17 producing oil wells on the property. Slick will continue to operate two pilot water floods gradually expanding them into full-scale operations. There are now 32 water-injection wells in the program.

In a $750,000 deal, Andrew M. Howsley and Charles E. Jacobs of Albany, Tex., bought 23 producing wells on the J. H. Nail ranch 15 miles northwest of Albany in Shackelford County. The wells produce 250 bbl. of oil daily from the Cook sand at 1,600 ft. The 880 acres of property was purchased from B. C. McMordie, Albany; Riley G. Maxwell, Abilene; and Edgar Davis and Art J. Frazier and associates, Abilene.

United Fuel Gas Co. is a step closer to developing its nineteenth natural-gas underground storage project in West Virginia. The Federal Power Commission has given temporary authority for the 14,800,000 M.c.f. storage in Kanawha County. It will cost $1,571,000.

United Fuel says maximum storage will be reached in 1960, providing an estimated peak-day capacity of 110,000 M.c.f. Annual withdrawals at that time will reach 6,000,000 M.c.f. The new storage will be United Fuel's third largest in West Virginia.



MAGNOLIA entry in deep-drilling derby makes . . .

Oklahoma Records Shaky

● Geological wildcat drilling on flank of Cement field now heads for 18,000 ft. hunting for the elusive Simpson

DALLAS.—A rank geological wildcat in South-Central Oklahoma was quietly slipping up on that state's deep-drilling record last week.

And there is a possibility that it could threaten the 22,570-ft. world depth mark too if everything goes just right.

The wildcat is Magnolia Petroleum Co.'s 1 Sterba-Ordovician on the south flank of the big Cement field structure in Caddo County. At midweek the deep test in SW NE SW of Section 35-6n-10w was drilling in shale at 17,760 ft.

The Oklahoma drilling-depth record is held by the Frankfort 1 Pruitt, a Grady County dry hole drilled last year to the Springer at 18,158 ft. The state's producing-depth record holder is British-American Oil Producing Co.'s 1 Reed. It came in early this year at 15,575-15,645 ft. in the third Bromide-Ordovician sands, of the Knox pool in Grady County.

Although it is located in a long established producing area, the Magnolia test has bored through unknown territory since it penetrated the Sames sand of the Deese at the 6,000 ft. level. Location is in the deepest part of the Anadarko basin. And Magnolia, due to a lack of markers, has had to guess at the thickness of the various zones it will penetrate.

Object is Simpson . . . The company originally set up the test to drill to a maximum depth of 15,000 ft. or 200 ft. into the Arbuckle.

Its prime objective, however, is the Simpson section including the Bromide sands. They proved so prolific when tapped by British-American on the Brady-Knox structure in adjoining Grady County to the east. The section also includes the Tulip Creek, McLish, and Oil Creek sands. Reaching the Arbuckle was a secondary objective.

When Magnolia passed 15,000 ft. far short of its target, it decided to go another 3,000 ft.

It is approaching that depth now and is drilling in upper Mississippian shale still far short of the Simpson sands. Company geologists feel that the Simpson section may be as deep as 22,000 ft. The Arbuckle may go perhaps as deep as 24,000 ft. But geologists emphasize this is only an educated guess.

Operator staked surface location a calculated distance down dip from the target and is letting the bit drift steadily back up dip. Thus it has been able to keep heavy weight on the bit and make exceptionally good drilling time.

Magnolia is a bit nervous, however, over the growing stretch of open hole in the well. It set its last string of casing, 7⅝-in., at 14,527 ft. Since that time drilling has been almost exclusively in shale.

If the shale should start caving, it would cause trouble. The company figures it will have to keep its present hole size to go very much deeper. If it should have to set another string of casing soon to halt caving, chances of reaching its objective would be very slim.

Looking for marker . . . Currently, Magnolia is looking for a marker so that it can more accurately judge how far away the Simpson might be.

It can get a better idea of this when it tops the Caney shale of the Mississippian—which it expects to do any time now. Then it still will have to penetrate the Caney, Sycamore lime, and Woodford shale of the Mississippian, the Hunton lime of the Devonian, the Sylvan shale, the Viola limestone, and the Bromide limes and shales before topping the Bromide sands.

Magnolia geologists feel there is a good chance of getting production in the Simpson section if it can be reached.

They point out that the shallower pays have more than 1,000 ft. of closure on the big Cement field structure. This is one of the larger anticlines in Oklahoma. It is faulted from east to west along the north side and down-thrown to the north.

The geologists are betting that the structure extends on down as far as the Simpson. They got some encouragement when gas shows were encountered in the Springer below 14,000 ft. (from 14,510-40 ft.).

Production on the anticline extends about 15 miles from northwest to southeast and is about 4 miles across at the widest point.

There are 25 formations known to be potential oil reservoirs in the area. Probably the best is the Medrano sand of the Hoxbar producing zone beteen 4,000 and 5,000 ft. The Rowe also is a heavy producer.

The 1 Sterba is making hole rapidly, but it still has quite a distance to go before it will challenge for the world's deepest title. The record is held by the 1-L Humble-L.L.&E. in Plaquemines Parish, South Louisiana. It was drilled by Richardson & Bass, John W. Mecom, and Freeport Sulphur Co. to 22,570 ft. This well cracked the world-depth record by more than 1,000 ft. in late 1955.

What Natural-Gas Industry Will Spend

(In millions of dollars)

	Actual					Total forecast	Actual total
	1956	1957	1958	1959	1960	1957-60	1953-56
Production and other storage	179	372	241	199	184	996	593
Transmission	702	1,025	830	1,077	956	3,888	2,351
Underground storage	50	54	67	82	149	352	196
Distribution	467	499	692	737	835	2,763	1,556
General	70	103	88	105	131	427	217
Total	1,468	2,053	1,918	2,200	2,255	8,426	4,913

Gas Spending Takes Jump

● Record outlay of $2.13 billion anticipated this year; trend of heavy expenditures will continue next 4 years

NEW YORK.—The gas-utility and pipeline industry will spend a record-breaking $2.13 billion this year for new construction and expansion.

The American Gas Association reported the outlook after completing a national survey. The outlay is an increase of 37 per cent over last year's all-time high of $1.55 billion.

Expenditures over a 4-year period, 1957 through 1960, are forecast at $8.7 billion, with 97 per cent going for natural-gas facilities. This compares with $5.3 billion spent in the previous 4-year period (1953-56) and $4.7 billion in the 1949-52 period.

Nearly half of the 1957 outlay will be for transmission purposes—$1.028 billion. Other anticipated expenditures will include $560 million for distribution, $380 million for production, $106 million for general purposes, and $54 million for underground storage.

Network of lines . . . The gas industry now has a network of mains stretching nearly 524,000 miles after adding 28,450 miles in 1956.

Transmission facilities were expanded by 7,900 miles, field and gathering networks by 1,840 miles, and distribution mains for local service by 18,710 miles.

This expansion enabled the industry to add slightly more than its recent annual average of one million new customers. The industry now serves over 30 million customers, in addition to 8 million customers living beyond utility mains who used liquefied petroleum.

Natural-gas transmission facilities will be expanded at an estimated cost of $3.89 billion in the 1957-60 era, compared to $2.35 billion spent during 1953-56.

Natural-gas distribution facilities will require an expenditure of $2.76 billion in the next 4 years, against $1.56 billion in the previous 4 years.

Underground-storage facilities will be increased by $353 million in the next 4 years, an increase of 80 per cent in investment.

Gas to new area . . . The impact of curtailed housing activity this year is expected to be minimized by customer increases resulting from the recent introduction of natural gas in the Pacific Northwest.

Further increases in gas heating customers are also expected in areas where service restrictions have been in effect. The limitations are being reduced as the industry accelerates its expansion program.

Two major pipeline systems — by Pacific Northwest Pipe Line Co. and American Louisiana Pipe Line Co.— were completed in 1956 as natural gas construction expenditures climbed to $1.47 billion. Among the major projects in this year's outlay is an expenditure of $154 million by the Coastal Transmission Corp. and the Houston Oil & Gas Corp. for facilities to transport natural gas from the Gulf Coast of Texas to peninsular Florida.

Companies covered by the survey indicated that construction activities during the next 4 years will be financed 28 per cent from internal sources, 53 per cent from debt issues, and 19 per cent from new equity. These financing plans, the A.G.A. pointed out, may change substantially in proportion to future changes in the cost of money.

Next step is rules committee:

Gas-Bill Amendments Fail

WASHINGTON.—The Harris gas bill this week may be given its first shove toward a vote in the House.

Backers of the bill in the House commerce committee are hopeful of getting the bill before the rules committee. That group passes on the measures that are to come before the House and sets debate-time limit.

Indications are that the bill will come out of the commerce committee in pretty much the same shape as written by Chairman Oren Harris of Arkansas. Efforts to include such matters as curbs on direct and dumping sales of gas by pipeline companies were voted down on the first round in the committee and are not expected to be revived.

The committee lineup on the bill began to take shape last week. Two efforts to make major changes in the measure were defeated 17 to 13.

One of the proposals would have knocked out the ban on the use of cost by the Federal Power Commission in passing on prices. This was the same as one of the two amendments offered by the administration, later withdrawn by the President.

The other proposal would have continued FPC control over production from pipeline-owned wells. The bill provides that pipelines shall be treated the same as other producers in approving fair field prices for gas.

Outside boost . . . The Harris bill last week got a boost from an outside study group. It came in a report on the regulation of natural gas by the American Enterprise Association. The report was approved by an advisory board dominated by educators.

"There appears to be no decisive reason why market competition cannot generally regulate the field price of natural gas in the public interest," the study held.

With over 8,000 producers, there is less concentration in the natural-gas industry than in any other extractive industry except bituminous coal. As a result, the study said, "if any gas producer should attempt to hold out for a higher price than the other producers, he will simply lose his market."

Public-utility regulation always works imperfectly, the report said. It is inappropriate for competitive industries—"and the structure of natural-gas production has become more competitive in recent years, not less."

Pipeline Fight Flares

Natural-gas interests lodge protests as electric company contracts 30-in. San Joaquin Valley - Los Angeles gas line

LOS ANGELES.—An old feud between southern California electric and natural-gas interests broke out into the open last week.

Sniping which had gone on for months exploded into public broadsides over an announcement that a contract had been let for a 130-mile, 30-in. gas line. The line, contracted to Bechtel Corp., would deliver San Joaquin Valley gas to the steam-generating plants of Southern California Edison Co. around Los Angeles.

In addition to its hassle with the gas companies, Edison ran into trouble on another front soon after the announcement was made. A group of residents in exclusive Brentwood in West Los Angeles formed a committee to fight construction of the line through their neighborhood.

Such a line has been talked about for some time, but several gas-company officials had scoffed at the idea. Plans for the line were a club, they said, to force transmission companies to give Consolidated Edison an uninterruptible gas supply.

When it was disclosed that pipe was on hand and a contract had been let, three firms—Southern California Gas Co., Southern Counties Gas Co., and Pacific Lighting Gas Supply Co.—went to the state public utilities commission with a joint complaint.

The companies charged that:

... **No certificate** of public convenience and necessity has been obtained for the line, as required by the state's public-utilities code.

... **Enough lines** are available already to serve the electric company's gas needs—on an interruptible basis.

... **First call on natural gas** should go to Southern California's 2,190,000 home gas consumers.

... **The shortage of gas** in California should prevent large-volume users from having uncurtailable use of gas when they have facilities for burning other fuels.

... **The new line** will not reduce smog, as claimed by Edison. Rather, it will increase smog by making other large firms use fuel oil for longer periods of time. Too, small industrial users are not equipped to burn oil as efficiently as the steam-generating electric plants.

The joint complaint asked that the Edison pipeline project be held up pending a comprehensive study of California's natural-gas supply and requirements by the public-utilities commission.

The project . . . Pipe is already being delivered, and construction is to start as soon as clearances are obtained.

The line is part of a deal between Edison and Richfield Oil Corp., which would guarantee a 20-year supply of gas on an uninterruptible basis for Edison's power plants.

Value of the gas during this period has been estimated at $200 million to $300 million. The line, itself, would cost $24 million.

Edison's only comment regarding quantities of gas to be shipped was "several million cubic feet daily."

The line would be owned by Edison Securities Co., a Southern California Edison subsidiary. Edison Securities awarded the construction contract to Bechtel.

Route of the line has not been announced. It probably would originate in Richfield's holdings in North Coles Levee field in Kern County and terminate at Edison's steam plant at Wilmington.

In announcing the Bechtel contract, James F. Davenport, president of Edison Securities and executive vice president of the parent company, said the line would fill two needs:

... **Reduce smog** in the Los Angeles Basin by reducing the use of fuel oil.

... **Provide power** which is vitally needed in southern California.

"The Air Pollution Control District has requested that natural gas be used as a fuel insofar as it is feasible in the operation of steam-generating stations in the Los Angeles Basin," Davenport said. "And the pipeline project marks an important step in Edison's efforts to bring more gas into the area."

Earlier this spring Edison and El Paso Natural Gas Co. signed an agreement calling for delivery of 50 million to 300 million cubic feet of gas daily over an 18-year period.

The deal calls for El Paso to deliver the gas to the California border, where it is picked up by Southern California Gas and Southern Counties Gas, which, in turn, deliver an equal amount to Edison's plants in Los Angeles, subject to peak-day curtailments.

Feud's beginning . . . The dispute between the two industries has its background in the subject of natural-gas imports to California from New Mexico and Texas and how much of this gas should be available to the electric company.

The two clashed in January 1956, when Southern California Gas and Southern Counties Gas asked for a permit to build the 241-mile Topock, Ariz. to Newhall, Calif., 30-in pipeline now nearing completion.

In its petition to the state public utilities commission at that time, the two gas companies asked and received permission to divert large quantities of imported gas from the line to a large cement plant at Victorville, Calif., 100 miles east of Los Angeles.

The Edison company vigorously opposed the plan, contending the diverted gas could be more wisely used in the Los Angeles Basin as a substitute for fuel oil in steam generation and thus cut down on the growing smog menace.

Since that time the two utility industries have been at loggerheads at other P.U.C. hearings.

Petrochem Plant Set

To add 150 million pounds of ethylene oxide capacity

CHARLESTON, W. Va.—A major plant for producing basic petrochemicals is being added to Union Carbide Chemicals Co.'s West Virginia properties.

The plant is to be located near the town of Winfield, about 20 miles down the Kanawha River from Union Carbide's main chemical plant at nearby South Charleston. It will serve both South Charleston and the intermediate plant at Institute with ethylene, propylene, ethanol, ethylene oxide, and isopropanol.

New capacity in these basics is needed for Union Carbide's growth in every direction. President D. B. Benedict said. Initially, capacity for making 150 million pounds of ethylene oxide will be installed. This raw material will be converted to ethylene glycol and other intermediates, and finished chemicals at South Charleston and Institute. Ethanol will be available for sale to industry, and for transfer to the other two chemical plants for conversion to other finished chemicals.

It is understood that raw feed stock to the new plant will be locally produced natural gas. Total plant cost was unannounced, but it is conceded that it will run over $50 million.

The Winfield plant is Union Carbide's fourth new plant to be added since World War II. The company

began operating the war-built Institute plant in 1947. In 1955 operations commenced at Seadrift, Tex., and last year the Torrance, Calif., plant was completed. Winfield would be Union Carbide's eighth plant to be based on natural gas and refinery gas as petrochemical sources.

Gas Line Planned

Third Canadian pipeline may be finished in 1958

CALGARY.—Canada's third major natural-gas outlet—from Alberta's Savanna Creek field to Idaho—may be completed in 1958.

Frank M. McMahon, president of Westcoast Transmission Co., Ltd., said he is optimistic about getting governmental approval for the proposed 30-in. line. Authority is needed from both federal governments and the Alberta government.

The 174-mile line would connect with a proposed U. S. line that Pacific Northwest Pipeline Co. would build from Spokane, Wash., to Idaho's international border.

This would be the second Westcoast line to link Canada with Pacific Northwest's U. S. system. Westcoast's 650-mile line from the Peace River area of Alberta and British Columbia, to Sumas, Wash., will be completed this summer. It will connect with Pacific Northwest's line to Sumas.

Canada's other major gas outlet will be the 2,250-mile Trans-Canada Pipe Lines, Ltd.

Tankers Tied Up by Strike

LOS ANGELES.—Strikes have tied up five tankers on the West Coast and one more is threatened by a strike as soon as it hits an American port.

The Radio Operators' Union and the Marine Engineers Beneficial Association are demanding a 13 per cent wage increase plus 2-months vacation and other fringe benefits.

The six tankers are owned by Pacific Coast Transport Co., under charter to Union Oil Co. of California. Union Oil officials said the two unions had already accepted an earlier 6 per cent boost and are now raising their demands.

William H. Buttram, business agent for the Marine Engineers Local 79, said the higher increase is necessary to bring crews' wages up to "parity with the other steamship operators in the United States."

Two of the tankers are idle in Los Angeles Harbor, one in Portland and two in Seattle.

Pipeline briefs

Four Corners Pipe Line Co. has been refused a certificate of public necessity for fast tax writeoff of its 750-mile crude system being built from Aneth field, Utah, to Los Angeles. Four Corners sought fast writeoff for $50½ million of its investment. The Office of Defense Mobilization pointed out tax benefits apply only to military-related projects.

El Paso Natural Gas Co. will ask for approval of 342 miles of new main line and 799 miles of gathering lines in a hearing opening before the Federal Power Commission July 8. Estimated cost of the facilities is $162,602,000.

New facilities, including 115,670 compressor horsepower, will be located in Arizona, Texas, and New Mexico. El Paso proposes to increase deliveries by 75,000,000 cu. ft. daily to Southern California Gas Co. and Southern Counties Gas Co.; 75,000,000 cu. ft. daily to Pacific Gas & Electric Co.; 35,000,000 cu. ft. daily to Arizona customers; and 100,000,000 cu. ft. daily to Southern California Edison Co.

Union Gas Co. of Canada, Ltd., has let contracts to Bechtel Corp. to lay 142 miles of 26-in. from near Sarnia to near Toronto, Ont. The project is scheduled to start September 10 with completion November 10.

Service Pipe Line Co. will complete a new microwave system for its Missouri division this month. The 160-mile system will have seven stations and will operate between the Freeman pump station and La Plata, serving the main crude line. The system will utilize nine channels of the 12-channel system for voice messages for operations and dispatching; one for centralized monitoring and remote control; one for microwave equipment fault reporting; and one for microwave maintenance personnel.

Coastal States Gas Producing Co. will lay a 20-mile gathering system, the twenty-first in the company's network, to move gas from the Rock Island area of Colorado County, Texas, to the United Gas Corp. system. Coastal operates gas-gathering systems and products natural gas, crude oil, and condensate from properties in South Texas.

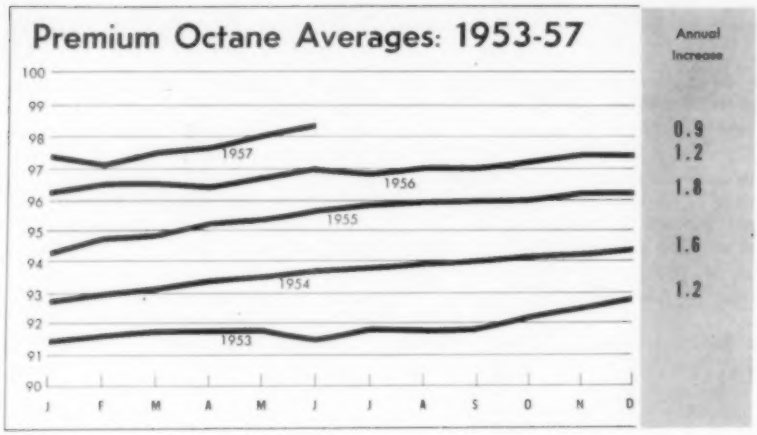
Michigan Wisconsin Pipe Line Co. has temporary FPC authority to build and operate 22 miles of 24-in. loop line in Illinois and Wisconsin. Estimated cost of the project is $1,823,000. These two 11-mile loops will result in complete looping of Michigan Wisconsin's main line.

North Canadian Oils, Ltd., plans to build a 47-mile pipeline to carry natural gas to the resort town of Jasper, Alta. The line would be an extension of North Canadian's 136-mile 10-in. line from Wabamun to Hinton west of Edmonton. North Canadian is negotiating with Northwestern Utilities, Ltd., Edmonton, the company which proposes to distribute the gas at Jasper.

Also for Pipeliners . . .

Onshore facilities bore the brunt of Hurricane Audrey as the oil industry launches a cleanup of the devastation (p. 69) . . . A new firm, Trans-Western Pipe Line Co., is laying plans for a gas line from the Four Corners area to California (p. 75) . . . The gas-utility and pipeline industry will spend a record $2.13 billion this year for new construction and expansion (p. 79) . . . The Harris gas bill is moving nearer a House vote. It's next hurdle is the powerful rules committee (p. 79) . . . Natural-gas interests in California are protesting an electric company's contract for a 30-in. San Joaquin Valley to Los Angeles gas line (p. 80) . . . Canada's third major gas outlet—from Savanna Creek to Idaho may be completed in 1958 (p. 81) . . . Creole puts its gigantic gas-injection plant into operation on Lake Maracaibo (p. 85) . . . Aristotle Onassis is dealing with Egypt's Nasser on a big-inch pipeline paralleling the Suez Canal (p. 86).

PLUS THESE TECHNICAL FEATURES: The automatic pipeline has been in the making for 30 years. A 15-page special section tells where it is today and how it got there (p. 89) . . . and Pipeline Patrol's construction report (p. 147).



Premium Gains at Record Pace

PREMIUM OCTANE averages in 1957 may make the biggest increase in 5 years. Based on first-half reports from Ethyl Corp., they will equal the 1.8 number rise of 1955 if the trend holds the rest of the year.

There are indications, however, that the upward trend is running out of steam, that much of the 1957 gain has already taken place, and that the year as a whole won't come up to the first-half in gains.

Premium's average gain for June was two-tenths of a number. It was the fourth successive increase, putting the total jump for the year at 0.9 of a number.

The national weighted average for June was 98.2 octane for premium, up 1.2 octane numbers above the level of a year ago.

Determination of the two-grade suppliers not to let the three-grade brands have the high-requirement market to themselves is indicated strongly in the June report. There were 19 suppliers of premium marketing brands in the 99-octane and up category and three marketing 100-plus.

The high-octane premiums were meeting the competition on a wide front, too. Five of the 19 suppliers in the 99 and up range were marketing in 10 or more of the 57 cities surveyed. One was selling in 25 cities and another in 18.

100-octane area . . . The 100-plus premium was limited to the eastern seaboard area from Boston to Charlotte, N. C., and to two inland cities, Pittsburgh and Buffalo. Baltimore and New York were the only cities with more than one supplier of 100-octane premium.

The 11 samples of 100-plus premium which showed up on the survey had an arithmetical average of 101.1. This included two of 100.2 octane and two of 101.4 at the extremes.

Twenty-six of the 36 samples of third grade were 101 or higher, with several at the 101.8 level. The peak was 102. Lowest of the third-grade samples was 100.2 octane, the same as the lowest for premium.

The presence of 11 samples of more than 100 octane among the premium-grade brands tested in June compared with nine in May.

Another indication of the June increase was the number of cities with averages of 99 or more. In May there were four cities in this group. In June there were seven—Baltimore, Boston, Charlotte, Hartford, Newark, New York, and Richmond. Baltimore and Hartford, each registering an average of 99.2, were the highest in the country.

West Coast averages were still well below the national average, but for the first half they have showed a better rate of increase than the rest of the country. Top octane averages on the coast were in San Francisco and Portland, both with 97.8. The low was Spokane's 97.4. The average increase on the West Coast, however, is slightly more than 1 octane number for the year to date. The national gain is 0.9.

Regular up, too . . . Regular gasoline averages were also up 0.2 in June. They hit 91.0. A year ago they were at 90. The highest figures for regular were in the highly competitive New York-Newark area where the rating went to 93.1.

Ethyl's June Survey

PREMIUM

	June 1957	May 1957	June 1956
90-90.9	0	0	0
91-91.9	0	0	0
92-92.9	0	0	1
93-93.9	0	0	1
94-94.9	2	2	3
95-95.9	1	1	7
96-96.7	0	7	18
97-97.9	21	18	23
98-98.9	26	25	1
99-99.9	7	4	0
Total cities	57	57	57
Weighted avg. R.O.N.	98.2	98.0	97.0
Weighted avg. TEL, ml./gal.	2.62	2.60	2.58

REGULAR

	June 1957	May 1957	June 1956
81-81.9	0	0	0
82-82.9	0	0	1
93-83.9	0	1	0
84-84.9	1	0	0
85-85.9	1	0	2
86-86.9	0	1	6
87-87.9	3	4	7
88-88.9	9	15	10
89-89.9	17	13	9
90-90.9	5	3	3
91-91.9	5	8	9
92-92.9	11	10	7
93-93.9	5	2	0
Total cities	57	57	54
Weighted avg. R.O.N.	91.0	90.8	90.0
Weighted avg. TEL, ml./gal.	2.19	2.14	2.32

Coast Prices Cut

Atlantic's postings in two gulf areas are adjusted

DALLAS.—Atlantic Refining Co. last week cut prices by 10 and 13 cents for crude oil it purchases in two fields on the Texas Gulf Coast. New postings were effective July 1.

The 13-cent cut was made for crude from Greta Deep, Old Refugio Light, Refugio North, Refugio New, Refugio Heard, Refugio Fox Light, Hynes Ranch, and Mission River. New postings start at $3.05 bbl. for oil below 20° gravity and advances to $3.47 bbl. for 40° gravity and above.

A 10-cent reduction was made on crude from Aransas, East Aransas, Corpus Channel, Mustang Island, Red Fish Bay, and Stedman Island. The new postings start at $2.93 for below 20° gravity and rise to $3.35 for 40° gravity and above.

The cuts were in the nature of an adjustment. The Refugio area crude was given a 40-cent boost last January, while Corpus area oil got a 35-cent hike. The cuts put them back to 27 and 25 cents a barrel higher than prices prevailing before last January's increase. That is nearer the average increase posted for other crudes.

Following Atlantic's new postings, Southern Minerals Corp. of Corpus Christi, cut its crude prices 5 to 10

cents on some high-gravity and Miranda crudes in South Texas. New postings bring a high of $3.55 for the best grade of 40°-plus gravity crude. This scales down to a top price of $3.37 for 26°-gravity crude.

Meanwhile, Gulf Refining Co. increased its price on low cold test crude from Orange field by 38 cents per barrel. This applies only to the crude from this field which is desirable for lube-oil production.

Storage Deal Made

Time Oil makes its first move off the West Coast

LOS ANGELES.—Time Oil Co., West Coast storage and marketing company, has organized Pipelines Junction Center, Inc., to build and operate a products storage terminal at Drumright, Okla. The terminal will have 1,000,000 bbl. in storage.

Pipelines Junction has purchased tankage from the mothballed refinery of Tidewater Oil Co. near Drumright and is installing pipeline connections and pumping units. Additional storage is being rented from Oklahoma-Mississippi River Products Line, Inc., at Drumright.

R. D. Abendroth, president of Time Oil and the new company, said the terminal represents an investment of $1½ to $2 million. It will start operating July 28 when it is scheduled to receive first products from Oklahoma-Mississippi River.

"We bought this property because of its position," Abendroth said, "being at the junction of several pipelines. We will be able to receive, store, and transship all liquid petroleum products." He said Pipelines Junction would confine its operations to storage. This is Time's only venture away from the West Coast and Abendroth said no others are contemplated.

Drilling Barge Claim Paid

HOUSTON.—American Tidelands, Inc., has accepted a $780,000 insurance settlement covering the loss incurred when its drilling barge capsized off the Louisiana coast 2 years ago.

Lloyd M. Bentsen, Jr., American Tidelands president, said the company will dismiss its $954,000 claim against the insurers. The claim has been pending in court.

The barge, known as the "101," was salvaged after the accident and has resumed drilling off Louisiana. Underwriters of the vessel included Lloyds of London and other British insurance companies.

Processing briefs

World demand for jet fuel last year exceeded that for aviation gasoline. Last year's consumption of 105,000,000 bbl. will double by 1962, while avgas demand will level off at about 110,000,000 bbl. by 1958 and decline slowly thereafter.

These estimates come from H. Austin Murray of California Texas Oil Co., Ltd. He attributes the rise in jet-fuel usage to date largely to military consumption, but says civilian airlines will become major consumers next year as the flood of new jet transports begin operation.

The latest tally of airline orders indicates that by 1962 more than 800 turbine-engine transports costing over $2 billion will be in operation. Between 30 and 40 per cent of operating cost with these new planes will represent fuel. This contrasts with aviation gasoline which takes only about 22 per cent of the total outlay required to keep piston-engined craft in operation.

Continental Oil Co. has completed its 60,000-M.c.f gasoline plant in Short Junction field south of Oklahoma City. The plant cost $1,750,000. It will extract butane, propane, and natural gasoline from gas produced in about 80 Conoco oil and gas wells in the field.

Sinclair Oil & Refining Co. will install a deisobutanizer at its Covington field plant in Garfield County, Oklahoma. The unit, with a capacity of 20,000 gal. daily, will separate isobutane from normal butane. Completion is scheduled for January 1, 1958. The Covington plant processes 18,000,000 cu. ft. of gas daily. Total production of products is 55,000 gal. daily.

Spencer Chemical Co. has added production of urea to its Vicksburg, Miss., petrochemical works. The new plant, using the Italian Montecatini process, has a capacity of 10,000 tons a year. Raw materials, ammonia and carbon dioxide, will be supplied by other plants at the Vicksburg facility, which was constructed in 1954.

Texas Natural Gasoline Corp.'s new plant is on stream 30 miles southeast of Glendive, Mont. The plant processes 8,000 M.c.f. of casing-head gas daily. Recovery is 80 per cent propane, with the remainder butane and natural gasoline. Shell Oil Co. is using dry gas from the plant to operate equipment at Pine and Cabin Creek unitized fields. The rest is sold to Montana-Dakota Utilities Co.

Cooperative Refinery Association will build an HF alkylation unit at its 22,700-bbl. Coffeyville, Kans., refinery. The unit will cost more than a million dollars and will be built by Refinery Engineering Co., Tulsa. Construction will begin in September, with completion set for early 1958. The unit will be licensed by Universal Oil Products Co.

Standard Oil Co. of California, Western Operations, Inc., has completed a 2,000-ft. extension of its offshore submarine pipeline at El Segundo on Santa Monica Bay. The line serves Standard-Western's El Segundo refinery.

The new 20-in. line is designed to permit operations on the largest tankers now afloat. It reaches to a depth of 60 ft. at a point 1½ miles from shore. It cost more than $150,000. Th former line reached to a depth of 48 ft. a mile from shore.

Also for Refiners . . .

Coastal refineries fared exceptionally well during Hurricane Audrey. Some even operated safely through the storm (p. 69) . . . Sohio tests of Asphalt Ridge in Utah may turn up some new twists in recovery and processing of tar sands (p. 72) . . . Union Carbide is adding a major plant for producing basic petrochemicals at its Charleston, W. Va., properties (p. 80) . . . Premium octane averages are making their greatest strides since 1955 in the first half of 1957 (p. 82) . . . Time Oil will build and operate a products-storage terminal at Drumright, Okla., (p. 83) . . . Ethyl reveals details on its new additive. The manganese octane-improver looks good, especially to the aviation industry (p. 84) . . . Stanvac needs new reserves in Indonesia to back up its Palembang refinery (p. 87).

PLUS THESE TECHNICAL FEATURES: Sohio "proves out" a medium-size, general-purpose, analog computer (p. 121) . . . A progress report on petrochemicals in the United Kingdom (p. 126) . . . On the Job . . . In the Plants (p. 133) . . . The Foreman's Page (p. 136) . . . COST-imating (p. 141) . . . Field Processing (p. 143) . . . and Refiner's Notebook (p. 144).

Ethyl Unveils Compound

● New manganese octane-improver looks good, especially to the aviation industry, but Ethyl can't say yet when it will be commercially available.

NEW YORK.—Methyl cyclopentadienyl manganese tricarbonyl.

That's the new antiknock compound just announced by Ethyl Corp. (OGJ, July 1, p. 100).

This straw-colored liquid is very stable. Manganese comprises about a fourth of its total molecular weight. Its density is 1.4, its boiling point is 451° F., and its freezing point 34.6°.

Just when this promising new octane improver will be commercially available, or what it will cost, Ethyl can't yet say. The additive, termed AK-33X, is still considered to be in the research and development stage.

Any production plans will be guided by the response Ethyl receives from refiners and from the aviation industry. The full story of what Ethyl knows about AK-33X is still being told to customer companies.

Why the advance announcement? Ethyl has two reasons:

. . . **Its indicated importance** in aviation, attested by Curtiss-Wright Corp., prompted release of information to airline operators, who probably will be the first users.

Advance notice, Ethyl feels, would permit them to incorporate possible application of this additive to their piston-engine operations in the future.

. . . **Ethyl believes** that its possible use in motor fuel is of prime importance to refiners and automotive manufacturers.

A longer lead on commercial application in this field would give refiners the opportunity to weigh this possible new octane-improving factor in their long-range planning for higher quality motor fuels.

What's known now . . . The whole story on AK-33X is not yet told, although Ethyl has teams touring the oil industry to inform refiners on all points developed to date. At this time, these data are available for general publication.

The effectiveness of AK-33X varies widely with different hydrocarbon base stocks. It is more effective in raising antiknock ratings under the research method, than with the motor method. Also, it has proved most effective in those fuels which have good tetraethyl lead response to begin with.

On the other hand, it is less affected by the common antiknock antagonists, such as sulfur, which hamper the effect of TEL. In general, Ethyl says AK-33X is about twice as effective as TEL on the basis of research ratings alone.

But this does not mean that it will be competitive with TEL in most gasolines. The main reason is cost. Base stocks for manufacture of the new compound will be methyl cyclopentadiene, a component of refinery streams, sodium manganese chloride, and carbon monoxide.

As in the case of tetraethyl lead, some corrective agents will have to be added. This finished blend will undoubtedly prove more expensive than the conventional antiknock blends based on TEL.

Hence AK-33X is not expected to compete with TEL. But Ethyl believes that it will prove competitive with refinery processing for higher octanes.

Effect on aviation . . . In its first use in avgas, this cost factor will not loom so important.

Conventional piston engines now used in aircraft are generally conceded to have reached the end of their development, so far as major design changes are concerned. The advent of jet engines has dictated this.

Thus, the injection of a new power-improving additive such as Ethyl's should give existing piston-engined craft a boost which would probably not result otherwise.

Curtiss-Wright Corp. agrees. A series of cooperative tests were conducted on their 18-cylinder Turbo Compound engine by Wright aeronautical division at Wood-Ridge, N. J. What they found in testing the new additive led them to state that airlines can realize an immediate benefit from the use of AK-33X.

The additive increased detonation margins, thus improving combustion chamber efficiency and extending cylinder life. More important, CW reported that the new fuel blend will add 20 per cent to cruise power and 7 per cent, or about 25 m.p.h., to cruise speed.

This means improved performance for the Douglas DC-7's and the Lockheed Super Constellations which are powered with Turbo Compound engines.

This additive, says CW, will boost these planes into the 400 m.p.h. cruise performance range, competitive with turboprop-powered aircraft now under development or projected. Larger payloads and high altitude operation will also result, says CW.

In the expected first use in avgas, Ethyl states that the new additive will supplement but not displace TEL. The same noncompetitive relationship is expected to hold, if and when AK-33X is used in motor fuels.

Automotive difficulties . . . Some problems remain before Ethyl is ready to talk seriously about blending its new additive into motor fuel.

But based on its long experience in dealing with these problems, Ethyl feels that solutions will be found.

The problems revolve around engine durability. Automotive engine tests indicate several facts.

In certain concentrations, and under certain operating conditions, problems exist in both spark plugs and valves where AK-33X is used in conjunction with TEL.

The major engine durability problems concern exhaust-valve life under moderate and heavy-duty operating conditions, exhaust-valve lash loss under heavy-duty conditions, and spark-plug fouling under heavy-duty conditions.

Specifically in passenger cars, Ethyl states that spark-plug fouling will be the principal obstacle to overcome in using AK-33X as a primary antiknock agent.

In heavy-duty automotive service, valve lash loss will be an added problem. These evaluations and their cure are under intense study at Ethyl's Forndale, Mich., research lab.

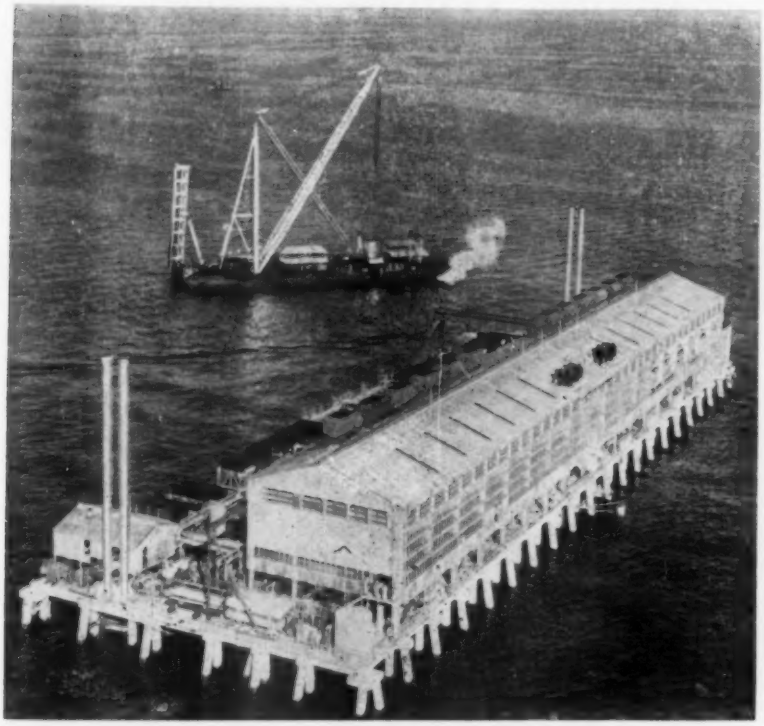
Border Test Is a Gasser

BROWNSVILLE, Tex. — Sun Oil Co. last week completed a gas discovery more than 10 miles from nearest production in South Texas' sparsely explored Cameron County.

The discovery is just southwest of Los Indios, about 20 miles from here, and just a mile from the Mexican border.

The well, 1 Cameron County Water District, is rated good for 8,000,000 cu. ft. of gas daily. Flow was through ¼-in. choke under pressure of 3,000 psi. Completion is in a Frio sand at 9,765-82 ft. Total depth was 12,186 ft.

Except for Hidalgo County's Lacy field, which extends into Cameron County, only three other fields have been discovered in the county. They are in the Brownsville-Port Isabel area. None has more than two wells. All of them tested gas and all have been shut in since completion.



CREOLE pours more into gas conservation in Venezuela as . . .

Giant Lake Plant Opens

Biggest of its kind in the world, Tia Juana station will conserve natural gas and increase ultimate oil recovery

CREOLE PETROLEUM CORP. has put into operation a $28-million link in its far-reaching conservation program in Venezuela.

The latest unit is a gas-injection plant in Lake Maracaibo. It is the largest such installation in the world, designed to inject 300,000 M.c.f. daily of gas into four reservoirs of the company's LL-453 area of Tia Juana field.

The new installation is named Conservation Plant Tia Juana 2 and is located 6 miles south of Plant 1 and 7 miles offshore from the Tia Juana area.

Creole President H. W. Haight in opening ceremonies declared "inauguration of the plant constitutes the most important step Creole has taken in its long-range program relating to efficient production of oil and the conservation of gas."

He said the company expects total investment for its conservation system to reach $175 million by 1960.

Creole will start work on a third plant in the Tia Juana area of the lake this month. Another plant is being studied for the Bachaquero area. In addition an L.P.G. plant is under construction at Creole's pipeline station at Ule on the eastern shore of the lake.

In Eastern Venezuela compression plants are in operation in San Joaquin, Mulata, Jusepin, and Quiriquire fields. They inject a total of 87 million cubic feet of gas daily. Creole also participates to the extent of 40 million cubic feet of gas daily in conservation projects with other companies.

Creole strategy . . . The new Tia Juana plant is a modified duplication of the first plant. They both fit Creole's general objective for its gas-injection program:

. . . Increase ultimate oil recovery from prolific Eocene sandstone reservoirs by maintaining pressure at high levels.

. . . Permit lower operating costs by continued production of wells by natural flow rather than by artificial lift methods.

. . . Conserve the gas by returning it to the reservoir for use later when its economic value will be much greater. Markets for natural gas in Venezuela are becoming more attractive with industrial developments of the country. Domestic markets also are beginning to develop, and a start has been made on constructing pipelines to move gas from producing field to market.

The gas handled by Creole's conservation plants contains large amounts of liquids. A Creole survey revealed growing demand for energy in both the Venezuelan and export markets opened a possible market for L.P.G. This led to construction of the Ule plant. The facility at Ule will produce 5,300 bbl. of propane, 5,600 bbl. of butane, and 6,000 bbl. of natural gasoline.

In addition to the gas from Plant 1, the Ule L.P.G. will also process some condensate from Plant 2. This will help recovery of liquids — will hit about 5 gal. per M.c.f. of gas.

The new plant . . . Preliminary studies for Tia Juana 2 began soon after a discovery well brought in LL-453 as a new oil-producing area.

The well was completed in April 1945 with an initial production of slightly more than 3,000 bbl. daily. Subsequently four reservoirs were found in the area. They are truncated Eocene monoclines bounded by a Miocene - Eocene unconformity, lateral faults, and a down-dip oil-water contact.

Surface area of the reservoirs is 9,874 acres. Thickness of the section ranges up to 410 ft. Net thickness of the producing sands ranges up to 360 ft. The average is 225 ft.

Creole engineers estimate that injection of gas through Plant 2 will increase ultimate recovery by a little more than one third. Immediate production increases, if any, will be negligible. Some individual wells may decline slightly.

The reservoir presently produces by dissolved gas drive with some gravitational segregation and the formation of a secondary gas cap.

Eight thousand horses . . . Tia Juana 2 is on a platform 440 ft. by 131 ft., longer and narrower than the first plant. It rests on 350 piles driven into the lake bed. Water depth is 85 ft. and the platform is 15 ft. above the water.

The piles are among the biggest used by Creole in the lake. They are

200 ft. long, of reinforced concrete, tapered from 36-in. square at the base to 24-in. square at the top. They are larger than piles used in the first plant, and 45 fewer were used. Creole cast the piles in its two yards at La Salina.

A two-story building with 23,408 sq. ft. of floor space houses the plant. Peak of the roof is 60 ft. above the platform.

Twelve gas turbines of 8,000 hp. drive a dozen centrifugal compressors. The total 96,000-hp. driving power is the biggest single concentration of gas combustion turbines in the world.

The turbine and compressor units are arranged in two six-stage compressor systems operating in parallel.

Inlet pressure of the gas is 39 psig. Outlet pressure is 1,800 psig. Twelve flow stations supply gas and there are four injection wells. Gas compressed for fuel will amount to 28,500,000 cu. ft. daily. There will be 3,000 bbl. daily of compression condensate.

The platform also carries four cranes. One has a 40-ton capacity to handle the turbines and compressors. An auxiliary 20-ton crane and two smaller cranes handle supplies brought in by launches and barges.

40-in. gathering lines . . . One of the most difficult jobs in the entire project was coating and weighting more than 28 miles pipe laid on the lake bottom.

The gathering system connecting the 12 flow stations with the plant uses a total of 121,500 ft. of 16-in., 24-in., and 30-in. pipe. The injection system has 29,100 ft. of 10-in. pipe.

One problem was to overcome the natural buoyancy of the gathering system, and to give maximum protection against the corrosive lake water. As a solution, an initial coat of asphalt was followed by a wrapping of fibre-glass cloth and heavy mesh wire. A 4½-in. thick coating was then applied.

Creole has preliminary design work under way on the first phase of an integrated over-all gas gathering system in the Bolivar coastal fields.

The system will be designed so that it can be expanded as needed until virtually all gas produced in the fields is gathered.

Gas is produced at low pressures, and in order to gather it from outlying stations with small pressure drops, lines as large as 40-in. diameter are needed. Creole has studied the anticipated problems in handling, weighting, and laying such large lines in water up to 100 ft. deep.

Creole's third lake plant will serve the TJ-102 area. It is in the early stages of design, and the company expects to have it in operation by 1959. The gas handling capacity will be the same as Tia Juana 2.

Onassis is dealing with Nasser:

Pipeline Would Parallel Suez

EGYPT last week broke its official silence on the 18-month-old deal Aristotle Socrates Onassis has been trying to make to build a crude-oil pipeline alongside the Suez Canal.

The Egyptians conceded they are talking to the Greek tanker magnate about the line, but they tossed in a major condition of their own. If the line is built, it will be controlled by Egypt.

Hassan Ibrahim, chairman of Egypt's Economic Organization, admitted last week that "negotiations are under way" between his government and agents of Onassis "and other oil-shipping companies" concerning a pipeline. He said an Egyptian stock company may be formed to build the pipeline with not more than 49 per cent of foreign capital allowed.

"We intend to keep control with 51 per cent of the shares," the Egyptian official said.

There was nothing in the latest reports to indicate the planned size or throughput of such a line. Ibrahim did say that it would be the cheapest "possible" and "cheaper than that which Israel is planning to build."

W. K. Whiteford, Gulf Oil Corp.'s president, has categorically denied Gulf is in any way interested in the contract for the proposed pipeline. His denial came after press reports originating in Cairo indicated Gulf was showing interest in the project.

Dealing with Nasser and his government has been risky at best during the past 6 months, but Onassis has built a world-wide reputation—and a fortune—on doing the unexpected. Oil observers were still watching quietly last week to see if this is a plan that may bear fruit or if it is another in an almost endless stream of propaganda that Nasser is making to regain his slipping hold on the Middle East.

Plan not new . . . Onassis made his original proposal for a pipeline paralleling the canal more than 18 months ago. It first came to light last December while the canal was shut down.

At that time the shipping multimillionaire confirmed earlier plans for the line, but said he was changing them drastically in view of the crisis.

He proposed building an emergency line to carry 500,000 bbl. of crude daily and said it could be built in 6 months. He said he planned to ask six companies operating in the Middle East to each lend him 20 miles of pipe for the line. None of the six took him up on his proposition.

He said at that time he had started engineering studies of the pipeline 3½ years ago and had waited more than 2 years to file an application with the government to build the line. His original plan was for three parallel 32-in. lines with a roadway and extensive pumping facilities.

U. S. firms are interested as . . .

Iran Studies New Oil Bill

IRAN may adopt a new oil law this month, which would open up large areas of the country to private development.

Elmer Batzell, Washington attorney who helped draft the proposed law, said the bill now pending before Iran's parliament provides for concessions under contracts negotiated with the government-controlled National Iranian Oil Co.

Operations could be carried out either in association with the government or independently. Reports from Iran indicate that a number of American companies are interested in several areas that would be opened.

Contracts would permit a company to gain concessions up to about 30,000 sq. km. in each district. The law apparently will throw all of Iran open to bidding other than the southern coastal area held by the international consortium. The area around the Qum area also is expected to be excluded.

The Qum area in northern Iran caused a sensation last summer when the government's 5 Alborz erupted and ran wild for weeks, spewing from 80,000 to 150,000 bbl. of oil daily. National Iranian Oil has declared it plans to develop Qum rather than lease the area.

As in other Middle East countries, all contracts under Iran's proposed law, would call for a 50-50 split of profits. Royalties would be collected in the form of a tax.

Parliament is due to adjourn around the middle of July, and the government is expected to press passage of the bill. Another bill was offered the parliament last May.

Stanvac Needs Reserves

● Planning group says company's production will start down in next decade unless new crude sources are found

STANDARD-VACUUM Oil Co. deserves a pat on the back for its healthy influence on the Indonesian economy.

It also is a company which will soon need more concessions if it is to maintain its present level of production past the next decade.

These were conclusions of a report made by the National Planning Association, a nonprofit organization studying United States business performance abroad.

As a contributor to Indonesia's economy, Stanvac is a major taxpayer and earner of foreign exchange. The jointly-owned subsidiary of Socony Mobil Oil Co., Inc., and Standard Oil Co. (N.J.) also has added to the country's resources and has opened new frontiers for development.

At the same time, the report illustrates a fact of life in the oil industry. A company is never too big to escape the need to make big cash outlays in the face of uncertainties.

STANVAC'S HOLDINGS in Sumatra, where most of the company's crude comes from, include two producing areas, crude lines from each area, and a refinery at Sungei Gerong.

Reserves dropping . . . The main uncertainty in Stanvac's Indonesian operation is that its ratio of reserves to production is sliced comparatively thin. Furthermore, the young government has been in no hurry to grant new concessions.

"The current outlook is that soon after the next decade, unless new fields are discovered and developed, it will be impossible to maintain capacity throughput of the Palembang (Sungei Gerong) refinery with crude oil produced by the company in Indonesia," according to the report.

Stanvac's stronghold is now in Central Sumatra where its production averages around 60,000 bbl. daily. Its fields in southern Sumatra are "over the hill." Output is down to about 2,000 bbl. daily and the last development well will be completed this year.

Lirik field will brighten the immediate future. It will go on production in a few months and produce an estimated 30,000 bbl. daily during its peak years from 1959 to 1961.

But in the near future, the company will need more acreage on which to carry out essential exploration programs.

Stanvac currently holds development rights on 1,845,000 acres out of a total of 16,800,000 acres in development concessions. The other Indonesia operators are Royal Dutch-Shell and Caltex.

The company had exploratory rights on another 4,200,000 acres in 1941 when the former Netherlands East Indies Government placed a moratorium on extension of contracts. Of this acreage, 1,750,000 acres were in South Sumatra, 1,426,000 in Kalimantan, 779,000 in Central Sumatra, and smaller parcels were in Java and North Sumatra.

In 1951, the parliament of the new Indonesian Government prohibited the granting of new exploration or development concessions pending a new oil law, which still hasn't jelled.

Faith and cold cash . . . Even with new acreage tied up so far, Stanvac has not hesitated to pour money into development of its Indonesian properties.

It decided on a $65,000,000 rehabilitation program after World War II at a time when political conditions were extremely unsettled. It agreed on another $70,000,000 to $80,000,000 investment program in 1954 during negotiations with the government on foreign exchange and tax policy.

Indonesian oil is expensive. The ratio of successful exploratory wells to total wildcats is about the same as in the U.S. Production is shallow. But because of difficut jungle conditions where most drilling is done, a Sumatra wildcat probably is more expensive than a wildcat to a deeper depth in the Middle East.

Field discoveries also have generally been small. Stanvac has averaged 21,700,000 bbl. of recoverable reserves per field. This compares with 269,000,000 bbl. in Venezuela and 1,500,000,000 bbl. in Saudi Arabia.

The main competitive advantage of Indonesian crude is its nearness to Far Eastern markets. In the 1930's Stanvac's Indonesian output of 29,000 bbl. daily accounted for more than 80 per cent of the country's total sales. Last year, Indonesian output of 66,000 bbl. daily took care of only 29 per cent of its market.

The government's side . . . The N.P.A. report gives credit to the government for continuing the Dutch agreements with oil companies after 4 years of bitter struggle.

Government policy now seems to favor Indonesian development of resources while recognizing the need for foreign capital in some areas. Here is what the government said in announcing its 1956-1960 economic plan:

"As a temporary step, the government must give additional exploration and development rights to enterprises that are considered to be lacking sufficient reserves, but are nevertheless sufficiently progressive in their attitudes toward Indonesian economic policy.

"For example, it is clear from a comparison of the three enterprises working in Indonesia that Stanvac occupies the weakest position as is clear from the estimates of the extent of their reserves.

"In making new concessions we must remember the basic governmental policy must be to advance in a progressive way the participation of Indonesians in the exploitation of oil resources."

Austrian Refinery Planned

THE AUSTRIAN Government refining company plans to build a 50,000-bbl. refinery at Schwechat, near Vienna, by 1960.

It also is studying a plan for a pipeline from Trieste to Vienna. The line would deliver Middle East crude if and when local production fails to meet refinery requirements.

Austria took over the company's, Oesterreichische Mineraloelverwaltung, from the Russians who operated it before their withdrawal in 1955. The firm operates a 8,600-bbl. plant at Lobau.

Venezuela Deal Made

Sinclair sells all rigs to Helmerich & Payne, steps up the trend in Venezuela toward drilling on contract basis

ANOTHER BIG Venezuelan operator last week pulled out of the drilling end of the oil-finding business.

Sinclair Oil Corp.'s Venezuelan subsidiary, Venezuelan Petroleum Co., sold all of its drilling equipment to Helmerich & Payne, Inc., of Tulsa. All of its future drilling will be on a contract basis.

The deal included four deep rigs, one shallow rig, rig haulers, large warehouse stocks, and related items. Helmerich & Payne also picked up Sinclair's drilling crews — all experienced in Venezuelan drilling.

Two of the deep rigs are presently contracted to Sinclair in the Barinas area. The other two are being moved into the Maturin basin of Eastern Venezuela near the town of Aguasay for contract with other operators.

This is the area where Sinclair recently brought in a prolific deep discovery at Aguasay 4.

Helmerich & Payne is moving its shallow rig to Quiriquire, northeast of Aguasay. The company said no long-term contracts have been signed and all rigs will be available for general contracting work.

What it means . . . The Sinclair sale is another step in a slow-moving trend away from operator-dominated drilling in Venezuela.

It is variously estimated that out of some 150 rigs in the country—about 115 rotaries and 35 workovers—operating companies still own from one-half to two-thirds of them.

But the situation seems to be drifting toward the pattern which developed in the U. S. a few years ago and which eventually resulted in the lion's share of drilling being turned over to contractors. An executive in one firm active in Venezuela explains it like this:

"Operating companies are deciding that contractors can drill cheaper in Venezuela just as they can in the U. S. But many of them are hanging onto their rigs until they run them out and then turning their work over to contractors."

Two other companies which previously made the switch to 100 per cent contract work were Phillips Oil Co. and The Texas Co. Loffland Brothers Co., which has 27 rigs operating in Venezuela, has purchased 14 rigs from operating companies during the past 2 years.

Interest in the Sinclair sale ran high throughout the drilling industry. The list of firms seeking the equipment read like a "Who's Who" of drilling contractors, with bids coming in from most of those already in Venezuela and a lot of others who would like to be operating there.

Cracks barrier . . . Helmerich & Payne officials are quite pleased with the deal.

The company, like a lot of others, had been wanting to get into Venezuela for several years. As one top official of the firm put it:

"We feel that Venezuela today offers the same kind of opportunity for the drilling contractor that existed in the United States 25 years ago."

But for 3 years the company held off, eying the prize from a distance while it worked out and put into operation a new program, which includes a rigid cost-control system.

When it was finally ready to make the move, it discovered as fact what it had previously suspected—the door to Venezuela is not an easy one to open. There was the problem of transporting rigs into the country. There was the big cost involved. And there was a tough barrier of red tape to be cut.

New subsidiary . . . There were so many problems, in fact, that the company was "at a loss as to how we were going to get in" until Sinclair made it known to drilling contractors it was ready to put its drilling equipment on the block.

In making its move into the country, Helmerich & Payne formed a wholly owned subsidiary, Helmerich & Payne, Ltd., and put one of its top men, Vice President Lee Daniel, in charge of operations. Daniel formerly owned his own drilling company in California.

Sun Drilling in Maracaibo

SUN OIL CO. is drilling ahead on its first well in Lake Maracaibo.

The wildcat is a tight hole. But Sun's confirmation that the deep test is drilling ahead discounts industry rumors that the well was being abandoned as a dry hole.

The test was spudded April 8 in the northeast corner of Block 1 in the central part of the lake. Sun is the operator. Its partners are Atlantic and Seaboard.

Sun will start its second lake test later this month on lot V-574 in the southeast part of the lake. It will have the same partners.

Trinidad Deal Near

Texaco set to buy oil firm with 53,000-acre concession

THE TEXAS CO. plans to expand its Trinidad operations by purchasing Antilles Petroleum Co. (Trinidad), Ltd.

McColl-Frontenac Oil Co., Ltd., sole owner of Antilles, has approved The Texas Co. offer, which is subject to the approval of the Trinidad Government. The Texas Co. owns about 65 per cent of McColl-Frontenac capital stock.

Last year, The Texas Co. obtained an 80,000-bbl. daily refinery at Pointe-a-Pierre and 27,000 bbl. daily of crude production when it acquired Trinidad Oil Co., previously called Trinidad Leaseholds.

The purchase of Antilles would give Texaco an additional 6,000 bbl. daily of crude production. Nearly half of this output comes from slant-hole wells under the Gulf of Paria.

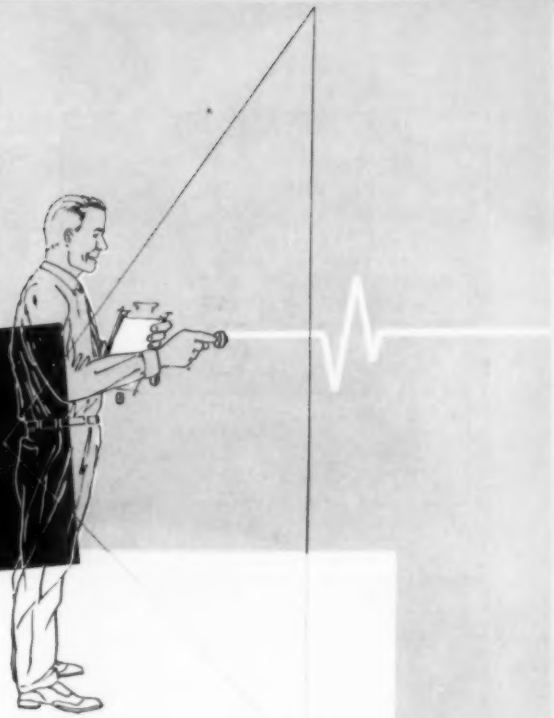
The Texas Co. is no stranger to Antilles operations. It financed Antilles exploration and development programs to the extent of $4,226,000 under an agreement which expired at the end of 1956. Repayment was to be made in crude, if discovered and developed.

Antilles has 53,000 acres under lease on Trinidad. Nine hundred acres are proven. Last year, the company drilled 50 commercial oil producers, two gas wells, and 10 dry holes.

Deep Test Staked in Cuba

THE southern coast of Cuba in Camaguey Province is getting its first deep well. Siboney-Caribbean Petroleum Co. of Tulsa last week was scheduled to start a 10,000-ft. test to the Middle Cretaceous zone. The wildcat is a joint venture of Siboney and Hudson Oil & Gas Co. of Shreveport. Cuban Stanolind Oil Co. is contributing to the cost.

The wildcat, 100 miles from the nearest deep test on the island, is just outside the town of Santa Cruz del Sur, a stone's throw from the Caribbean Sea. Siboney has been exploring the area for the past 3 years. The company has leases on some 4 million acres in Cuba.



The Automatic Pipeline

WHERE does the pipeline industry stand today on automation? And what will the automatic pipeline of tomorrow be like? Now is a good time for a hard look at the technical, economic, and human issues involved.

The automatic pipeline has been in the making for 30 years, ever since the first unattended pump station was built. Automation in one form or another is being relied on increasingly to handle a growing job of transporting petroleum and natural gas economically and efficiently. The automatic pipeline has been put together a little at a time, and now the whole is complete—save for one final part.

Remote-controlled stations, and even systems, have become commonplace. The next chasm to be bridged is from remote control to a completely self-controlled system. This will mean turning over the chief dispatcher's decisions to a computer, which up to now has done almost everything with a pipeline but run it.

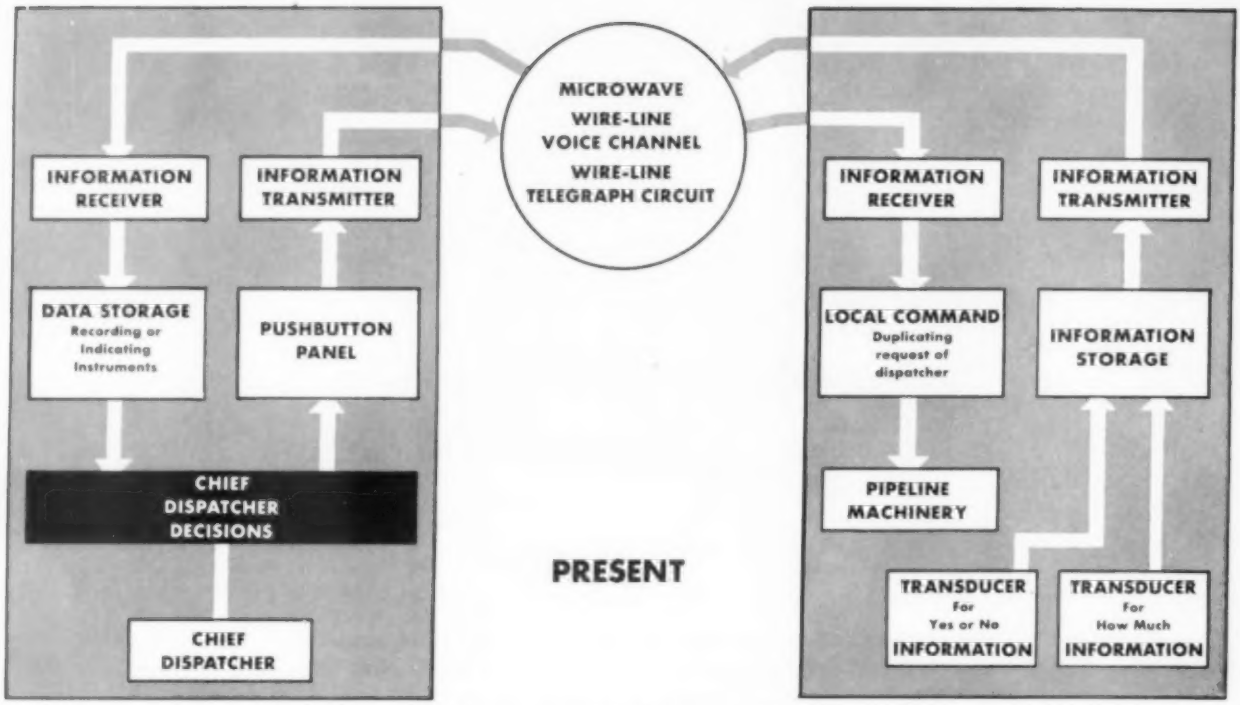
When and how this step will be taken are matters which are receiving closest scrutiny. So are other factors inherent in accepting this new way of doing things. Each company must answer for itself these questions:

How should the automatic pipeline be approached? What are the pitfalls, and how can they be avoided? How can we prepare for the automatic pipeline? Will changes in organization be necessary? How much automation should be embraced? And is today's instrumentation adequate?

What about the problems of security of data, methods of transmission, remote starting and stopping, protective devices, and the problems relating to remote gaging, metering, and automatic custody transfer? How can management and engineers bring about the wedding of business and science to assure the economic justification of the automatic pipeline?

A realistic appraisal of where we are today and what we may expect in the future is offered by an expert on pipeline automation in the 16-page special report which follows.

A SPECIAL FEATURE OIL AND GAS JOURNAL



CONTROL OF PIPELINE OPERATIONS today is represented by this diagram. The chief dispatcher has many instruments and much communication equipment to help him keep in touch. However, the decisions are all up to him. The pipeline of tomorrow, diagram on page 101, will have a computer making calculations and many of the decisions.

TODAY we have

"Pipeline Machinery With Self-Control"

. . . what about TOMORROW?

By Max T. Nigh

Part I

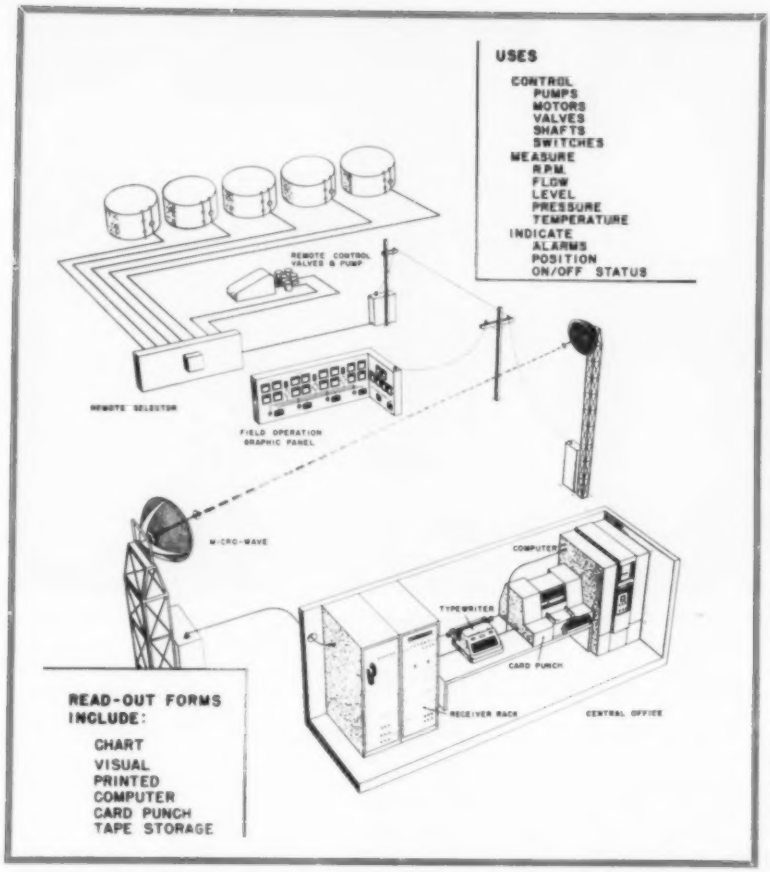
TO SURVEY the subject of automatic pipelines, we will cover today's automatic pipeline and what we can expect from tomorrow's automatic pipeline. Both the technical and the nontechnical aspects will be investigated so we may better appreciate what makes up the automatic pipeline and what its automatic parts can do for us.

We can first consider the nontechnical aspects of today's pipeline by a general definition of automation.

"Automation" has been appropriately defined by others as a new way of doing things. We believe the emphasis is on the "way" and not on the "new." The scientific principles used in the gadgetry of today for solving the majority of the automation problems have been available to mankind since and before Thomas Edison's time. The big problem facing us today as we go into the automation of the future is to apply these known principles in proper combinations to produce a system which will solve the problems of today and tomorrow most efficiently.

Let us say here then that pipeline automation of today is best defined by describing it as "pipeline machinery with self-control." We have many phases of automation covering pressure switches, electronic control instruments, supervisory control, telemetering, and closed-system operations. But the central aim of all phases is to engineer all of the operating machinery connected to a pipeline system so it is self-controlled.

Need for automation . . . We are finding increased use of these principles of automation in the pipeline industry due to a need to transport more oil and do it economically. The industry finds itself in a position where



A VITAL LINK in the automation chain is remote tank gaging. Here electronic signals check liquid level in storage tanks, turn valves and start pumps to deliver the proper amount of oil to pipeline. A computer supervises the process in the proposed setup shown. The gaging itself must be at least as accurate as manual methods. And there must be assurance through security checks that the level information is transmitted correctly, else the computer will come up with a wrong decision.

THE AUTHOR

Max T. Nigh is an engineer senior grade in the electrical section of the engineering department for Service Pipe Line Co., Tulsa. His work during the past 7 years has been in various phases of engineering pipeline design. Presently his activities are concerned with supervisory control, telemetering, and pipeline instrumentation, engineering design, and field installation.

He was graduated from University of Nebraska in 1945 with a bachelor of science degree in chemical engineering. Prior to coming to Service Pipe Line Co., he was employed by California Research Corp., as a process development engineer in the petroleum chemicals division.

He is a member of the American Institute of Chemical Engineers, the National Society of Professional Engineers, the Instrument Society of America, and is a registered professional engineer in the State of Oklahoma. Presently, he is president of the Tulsa chapter of Oklahoma Society of Professional Engineers.

it must do more work than ever before with the same personnel.

Today's pipelines are big! They are nearly twice as large and carry about four times the oil they did only 10 years ago. This then is an expanding industry with the end not yet in sight.

The large volume of oil movements today dictates that we have most reliable communication and control methods to permit operation of a pipeline with safety, dispatch, and economy. We realize that many of the gadgets of automation have been available to us for many years, yet never been put into practice or operation.

So it is apparent that part of the problem of using automation techniques is one of mental attitude. We talk about the automatic pipeline being the coming thing; it is difficult for us to believe that it is here, and here out of necessity.

Preparation for Automation

Before going into the technical aspects of today's pipeline, let us examine a few basic ingredients necessary to establish automation as the means to solve the problem attendant with more oil movements, larger pipelines, booster stations, and expansion to meet growing needs with essentially the same personnel. Before a company can start toward a program of automation, we believe the following three preparations should be made:

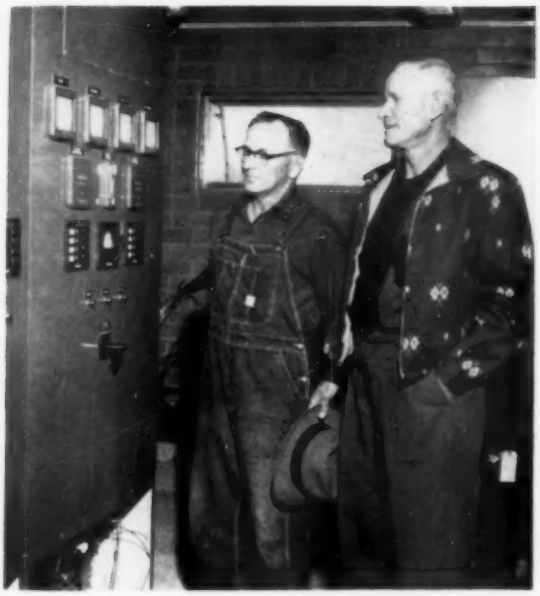
- Justify it economically.
- Educate as to its advantages.
- Train personnel as to its use.

Naturally other changes should come about before we can really be ready to take full advantage of automation facilities, but the three mentioned will at least prepare us for a start.

Economic justification . . . The economic justification comes about through the application of economic payout to the project. This requirement is most easily met by a systems approach to the installations under consideration. That is to consider all phases of the business operation to be certain that the automation equipment planned will be used in a manner to take full advantage of its labor-saving features.

A large amount of automation equipment, not integrated well into the business operation, is not going to prove economical. It is too costly to be applied without careful planning.

AUTOMATIC tank-gaging equipment at the Fort Laramie, Wyo., station of Service Pipe Line Co.



CONTROL and information panel at the Blake, Okla., station of Service Pipe Line Co.

Intangible advantages . . . In addition to economic advantage, there are many intangible advantages to pipeline automation, which is our second preparation for the program. These intangible advantages can improve the efficiency of the whole business operation. Therefore, many departments in the organization should be consulted, and the different techniques available discussed with them, in terms of their impact on each department.

Training . . . Now that the first two considerations are looked after, we turn to the third requirement—training personnel in the use of the automation equipment. Engineers in design and maintenance must, of course, train themselves in the technical aspects of the automation equipment, but other personnel using the equipment need only be trained to its use. They must be trained only in its outward effects on both ends of the automation system. This includes knowing what the data coming in mean in relation to the equipment being used, and the effects of the control actions requested. They must appreciate the security features built into the system.

Technical aspects . . . Leaving the nontechnical aspects of today's pipeline and going into the technical, we see on page 90 a simplified block form of the basic features of an automatic pipeline. Hypothetically, the chief dispatcher is the person responsible for its operation. He interprets all data coming into the centralized point and establishes any corrective action required in the pipeline system flow or pressure.

Information is transmitted to and from the satellite stations via the communication medium, be it microwave, voice carrier, or telegraph on wire line.

Unattended Station Operation

Automation on today's liquid and gas pipelines has consisted mostly of closed-system operation involving unattended satellite booster stations. Control of these satellite stations has often been done from a central control point, sometimes hundreds of miles away from the station.

In the crude-oil and products pipelines, electric machinery with centrifugal pumps has been most often used. In the gas-pipeline field, there are installations of 4,000-hp. gas-fueled diesel engines running centrifugal compressors under remote control from a centralized point.

In each case, economic considerations have been the prime cause for the choice of machinery. In a closed-system liquid pipeline, centrifugal pumps are the best pump adapted to this type operation. It is not uncommon to find electric-centrifugal booster stations approaching 3,000 hp. under remonte control.

Protective Devices

One fundamental engineering principle has prevailed in most unattended-station applications. This has been to make the satellite station secure in itself and, therefore, independent of the communication link with the central control point.

The station is equipped with a long list of protective devices that permit it to run without human supervision. As hydraulic conditions change in the line, the pumping unit will adjust itself to the new load, allowing the pumping unit to operate safely and within the pressure limits of the pipeline at all times.

Vibration protection . . . The most recent protective device applied to pumping machinery for unattended operation has been vibration protection. This device protects against ball-bearing failures which cannot be easily detected by temperature devices.

It is a primary detecting device for cavitation of the centrifugal pump and, of course, will detect vibration due to an object becoming lodged in the pump causing the impeller to be out of balance. Prevention of cavitation in the pump is usually threefold.

CONTROL ROOM of initiating station on products line embodies centralized panel design with electronic and electrical measurements and pneumatic control. Lower operating costs, increased protection to personnel and machinery are advantages of system.

In the case of electrical-centrifugal pumping units, a control valve is used to regulate suction pressure at about 50 psi. under varying hydraulic conditions. Secondly, a pressure switch detecting suction pressure at some level below 50 psi. is backup protection in the event the hydraulic condition exceeds the control valves' capacity to regulate.

And third, the vibration switch will back up the suction pressure switch. All three devices, then, tend to guarantee that cavitation of the pump will not take place. The pipeline itself is protected by a pressure switch set close to the pipeline operating limit established by desired operating pressure values.

Control valves . . . In the case of diesel-engine-driven centrifugal pumps, the pumping unit is tuned to the hydraulic condition existing in the pipeline by means of speed control of the unit. In the case of electric centrifugal pumping units, the pumping unit is tuned to the hydraulic conditions in the pipeline by means of a discharge control or throttling valve.

This throttling valve has, in the past, generally been an air-operated valve. At the present time, some pipeline companies are using electric-control-valve operators, thus eliminating the necessity for any air at the unattended station. Electronic measuring and control instruments are available for controlling the position of the valve operator, thus providing a complete electrical and electronic control system.

This equipment is essentially the same as used in the process control in refineries and chemical plants. In application, however, there is a big difference between them. Failure to realize this fundamental difference between the two applications has resulted in failure of the equipment to do the job properly.

In the case of the chemical-process application, the control valve is meant to throttle all of the time and hold the measured variable on the set point of the controller at all times. This is in contrast to the application of a throttling valve to an electric-centrifugal pumping unit in a liquid pipeline. If the centrifugal pump is sized correctly for normal pipeline operations, the control valve will never be throttling. It will remain open and will be ready to come into a throttling position only if the hydraulic condition in the line changes making its use necessary to avoid a shutdown.

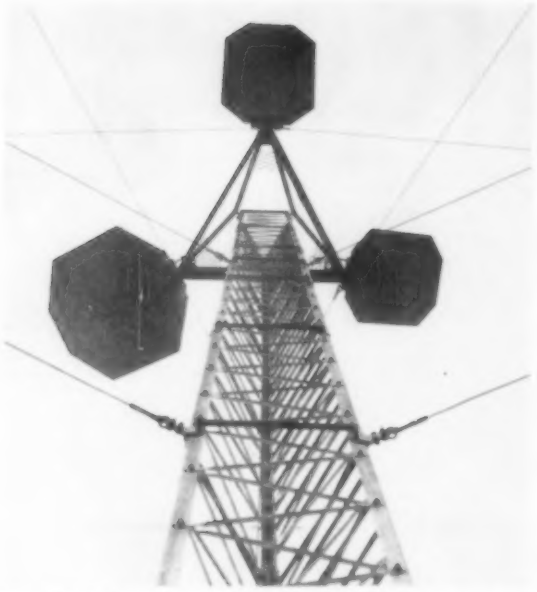
This means the control valve is usually not in a throttling position. Over 90 per cent of the time it is fully open. And when it is, it must be capable of going into action on a moment's notice. A 10-13-second stroking time is usually required to keep up with the hydraulic changes in the line.

Information

With machinery of the type described above at satellite stations, it is necessary to give the operator at the control point information concerning the unit status. A typical list of such indications is given below:

1. **Pumping unit on.**
2. **Pumping unit off.**
3. **Isolation gate valves open.**
4. **Isolation gate valves closed.**
5. **Station main breaker open.**
6. **Low suction pressure.**
7. **Communication circuit failure.**
8. **Pump-seal failure or high sump.**
9. **Current unbalance or undervoltage.**
10. **High pump-case pressure, high discharge pressure, or low suction pressure.**
11. **Machinery fault consisting of all protective devices on the pumping unit itself.**

Certain faults are grouped to conserve cost in the remote-control equipment and still provide all the necessary information for the most efficient type of operation from the controlling station. Low suction pressure, high discharge pressure, current unbalance or undervoltage are faults which can occur but are not of a nature which would prevent the pumping unit from being started again.



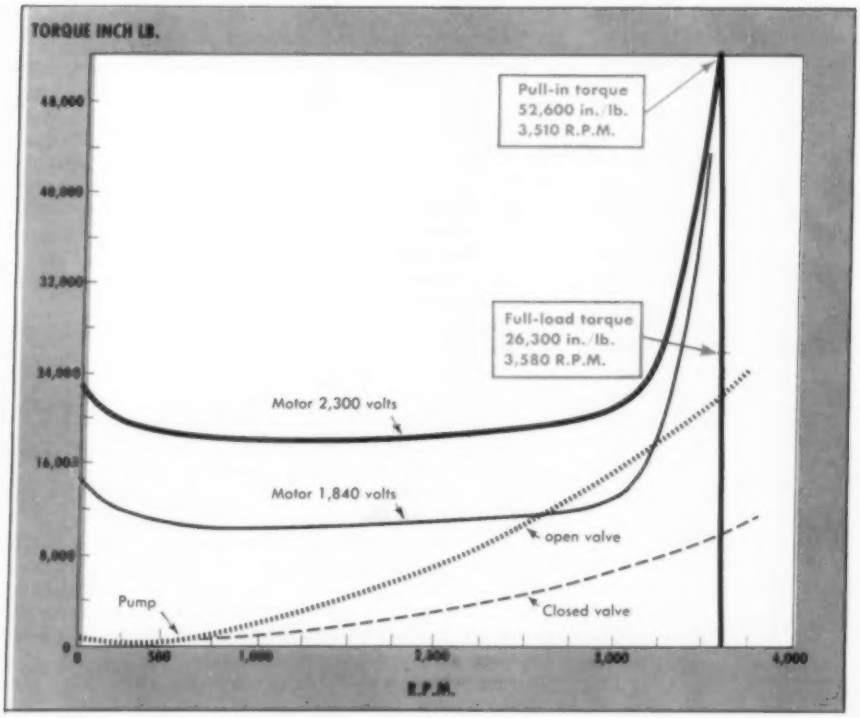
RELIABLE COMMUNICATIONS SYSTEM—whether microwave or wire line—is essential to successful remote operations. Security checks must be built in to guarantee accuracy of transmission and detection of errors.

NEW CONCEPT is incorporated in system controlled from this control board. Upsets are sensed by an automatic watchman, an alarm is sounded at the central station, and conditions on the system are telelogged on typewriter.

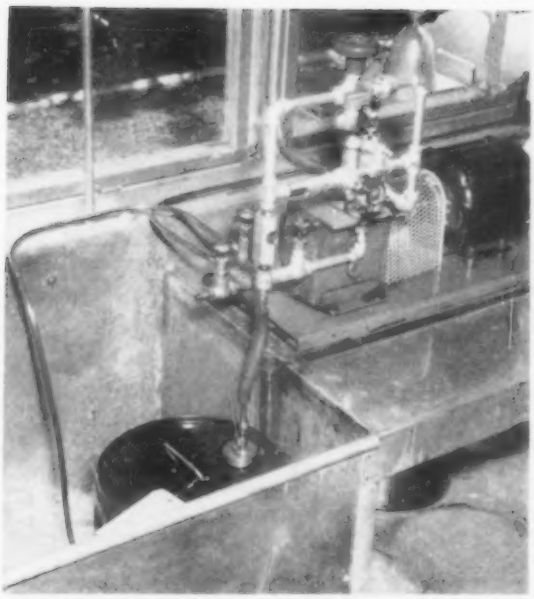
These faults, then, provide the operator at the control point with necessary information to permit his restarting the pumping unit with complete assurance that everything is all right at the unattended station. In the case where machinery fault or electrical failure has occurred, visiting the station is necessary before restarting the machinery. Local control circuits generally lock the pumping unit out when such machinery fault occurs, thereby preventing starting from a remote point, even if attempted.

Remote Starting

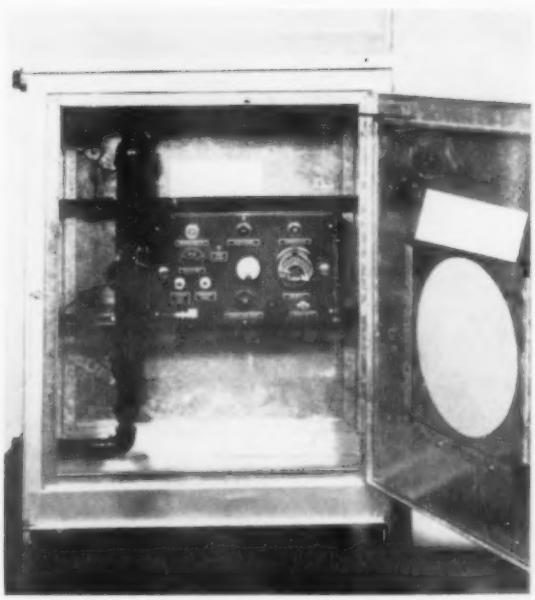
Starting of the machinery at an unattended station, by remote control from a centralized control point, usually involves starting a sequence of events at the unattended station. This sequence of events culminates



DROP in voltage during starting at an unattended station can be a very important consideration. This is shown by this torque-r.p.m. plot for a 10-in. single stage centrifugal pump with 1,500 hp. motor. Fig. 1.



CONTINUOUS SAMPLING for manual checking remains the practice. The main hurdle here, however, is definition and acceptance rather than reliability of monitors.



B. S. AND W. MONITORING enters picture where lease automatic custody transfer is involved, as does gravity measurement. Note probe and monitor control cabinet.

in the starting of the pumping unit, usually within 2 minutes.

A number of pipeline companies are using the technique where the isolation gate valves are started by remote control. And as they open at a predetermined point, the pumping unit is started by the gate valves reaching the three-quarter to full-open position. It is very important to allow the motor to come up to full speed in a minimum length of time, usually less than 15 seconds, and allow it to come up to speed with a minimum torque requirement from the motor.

With most pipeline booster stations on the end of a long power-transmission line, the drop in voltage during starting at an unattended station is a very important consideration. See Fig. 1.

Throttling . . . The minimum torque can be achieved during starting by allowing a minimum flow rate to occur through the centrifugal pump. The most effective device for throttling the centrifugal pump is the discharge control valves—not a gate valve.

We have local control circuits which close the control valve before the pumping unit starts and then allow the centrifugal pump to come up to speed with the centrifugal pump throttling against an almost closed control valve. It is therefore possible to get the motor or the pumping unit on the line in a minimum length of time and with the minimum torque required from the motor.

After the electric motor is up to speed, the control valve can be gradually opened. This will permit the increase in flow in the pipeline to take place gradually and also prevent the discharge or the suction pressure from exceeding preset limits.

This same principle of closing the control valve during the starting of machinery can be used with multiunit stations where only one control valve is in the line. The first unit can be started with the control valve almost closed. The second unit can be brought on the line with the control valve in a throttling position but not as closed as when the first unit came on the line. The third unit can be started with the control valve only partially closed.

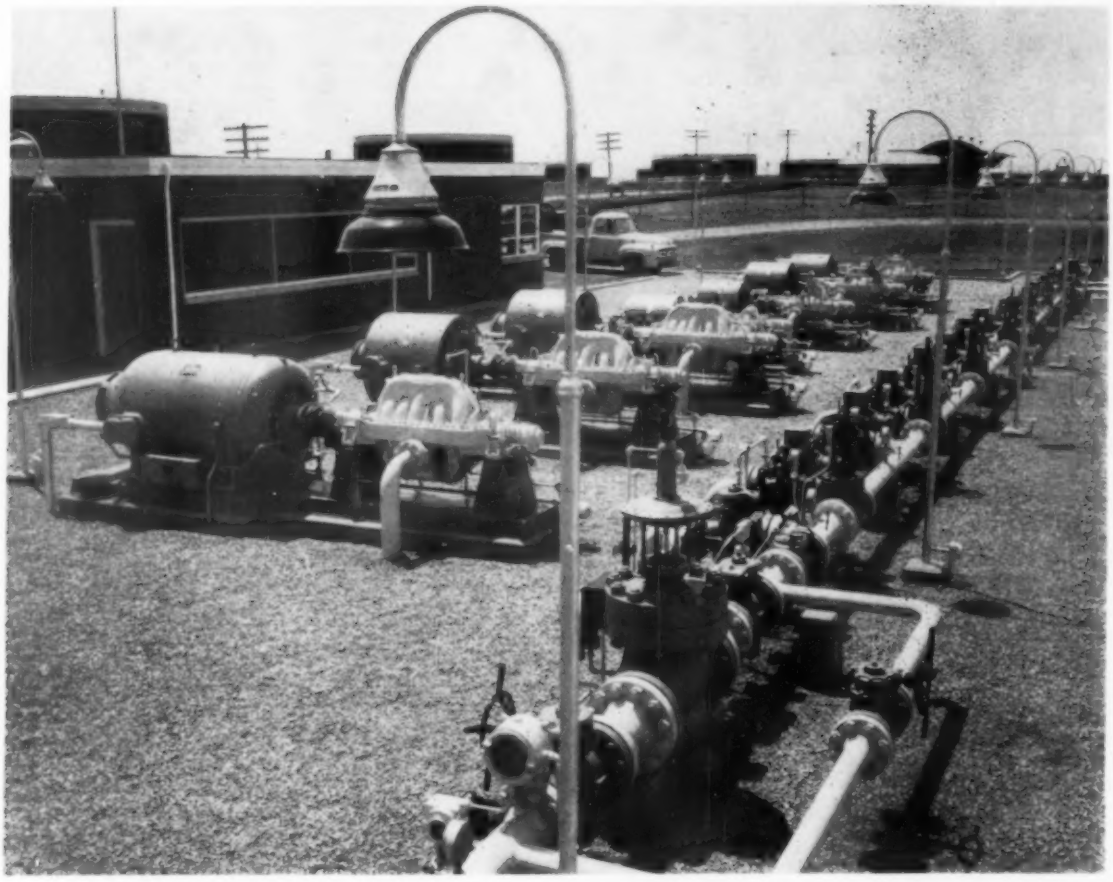
The second and third units could be started by cracking the gate valve in the discharge line and holding it at this position until the motor is up to speed. This way the control valve would not have to be closed as much. This technique will permit reducing the load on the electrical substation to a point where the second and third pumping units can be brought on the line without requiring excessive transformer capacity in the substation.

Control Circuits

All these techniques are local instrumentation and control applications. They are of a repetitive nature and remote control and remote monitoring of the sequence of events are not required. The use of remote control, however, has placed increasing demands of reliability upon the local control equipment and instrumentation. With remote control in the picture, we draw a simple comparison and say we have left the "three-wire control" picture and are entering the field of "many-wire" controls.

In the case of protective devices, this increase in number of circuits usually means that two electrically separate circuits must be controlled from each pro-

"Much automation equipment, not integrated well into the business operation, is not going to prove economical. It is too costly to be applied without careful planning."



OUTDOOR CONSTRUCTION offers opportunity to reduce station investment, make automatic operation more attractive.

tective device. This applies to all electrical protective relaying in switchgear as well as pressure and temperature switches and vibration devices. Pressure and temperature and vibration devices are now being built with provision for two electrically separate circuits from each device.

The electrical protective relay in switchgear, however, has not kept up with the pipeline requirement and, as a result, additional repeat relays are required from each electrical protective relay. Two electrically separate circuits from each protective device permit eliminating unnecessary repeat relays, and thus simplify the control circuits. This simplification, of course, is translated into more reliability.

Remote Control

The fundamental economic design of remote-control equipment dictates that pumping or remotely controlled facilities be controlled from one central point. Centralized control permits the economical use of equipment as well as personnel and adds the additional safety of placing responsibility in the spot where it will be accepted and depended upon.

Experience with closed-system pipeline operations has shown that a dispatcher or monitor requires information from all booster stations on the pipeline system in order to interpret information from one station with conviction. Just knowing what the conditions are at one station and any changes that might take place there is not enough information to adequately run that satellite pumping station.

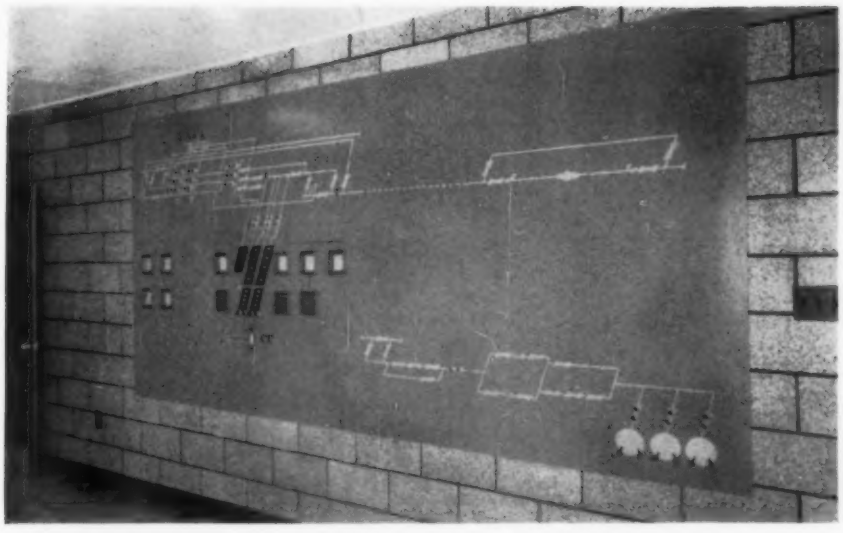
A closed-system pipeline must be treated as a unit irrespective of the number of booster stations in it. A person or monitor at a central point should be in a position to survey conditions at all the stations in a closed system. Only then can he best visualize the system operation and analyze the hydraulic situation existing within the system.

Pipeline Monitoring

With the unattended satellite-station machinery possessing self-control and, therefore, not requiring close supervision, we can turn our attention to monitoring the pipeline operation itself. This covers the flow into and out of the pipeline as well as the suction, case, and discharge pressures on each booster station.

The principle of current-flow comparison used for many years in the power-industry distribution lines is now being applied to the pipeline industry. For any given pipeline closed system, the flow into that line and the flow out of that line, be it 100, 300, or 600 miles away, is telemetered to one central point and compared for a dispatching check on the flow of oil in the pipeline. These two flow-rate readings are compared when hydraulic conditions are stable.

The suction, case, and discharge pressures at each satellite station permit the central dispatcher or monitor to evaluate the efficiency of the pipeline operation. He can dictate the flow rates which should be main-



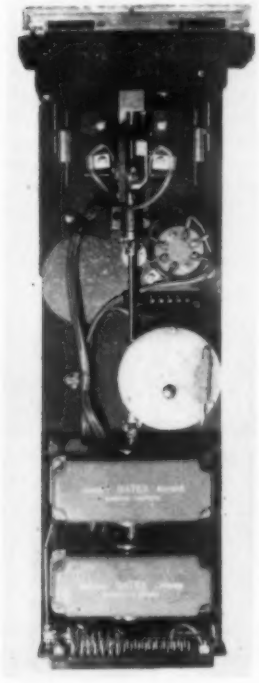
COMPLETE SYSTEM and all controllable functions are shown on control panel of first pipeline controlled entirely by electronics.

tained for economic operation. He can also start and stop satellite stations as they are required for the hydraulic conditions imposed by batching, customer demand, and operative machine availability.

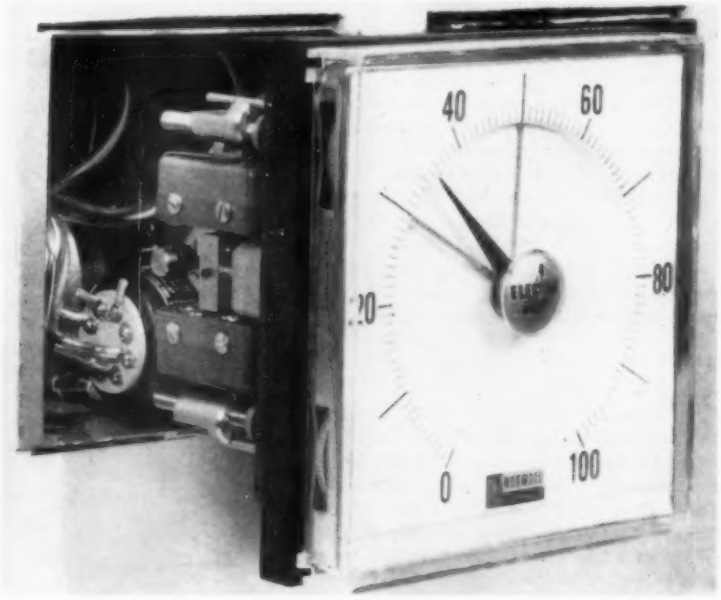
Rapid changes in hydraulic pipeline pressures are usually clues to hydraulic troubles in the pipelines. Providing the central monitor of the pipeline with an indication of when hydraulic pressures change rapidly permits the monitor to pin point troubles quickly and efficiently. Knowing the pressures at all satellite stations and the flows in and out of the pipeline, he can make decisions involving the isolation of certain line sections or whether to shut all satellite stations down.

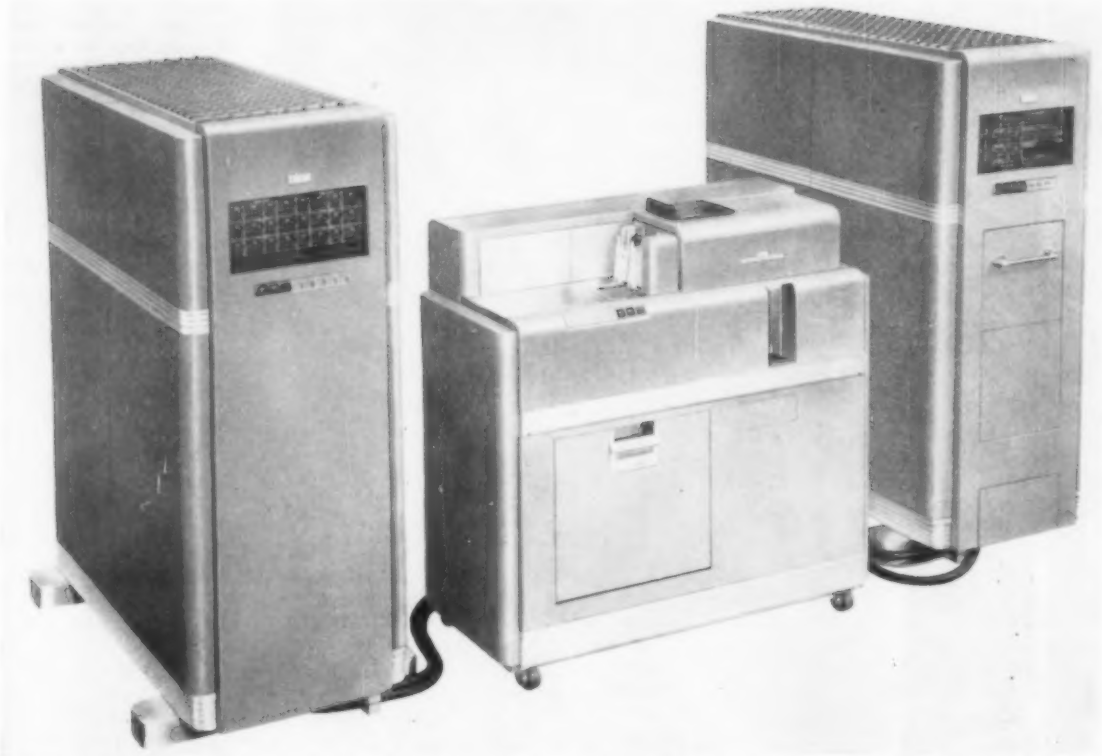
Telemetering, data logging . . . Supplying the above intelligence rapidly and in an easily interpreted form leads to the use of digital telemetering and automatic data logging. When the number of variables to be used in pipeline monitoring exceeds 12, the method of displaying the information for dispatching use is a problem requiring careful and thoughtful engineering. Printing of the data out on a typewriter or on a digital indicator places the data in a form which is most easily assimilated by the dispatcher. It certainly makes it easier for him to reach an intelligent decision concerning his course of action.

Digital vs. analog telemetering . . . In the past, the most common means of telemetering pipeline information has been the time-impulse method. This involves keying a narrow communication channel for a length of time proportional to the amount of the measured variable. On-and-off time periods are complements of



AN EXAMPLE OF SERVODRIVEN analog to digital conversion instrumentation for telemetering purposes is shown in these photographs.





TYING COMPUTER IN WITH PIPELINE SYSTEM will be the next—and final—step toward closed-system operation. The technical capability is present. The economic justification is down the road a way.

each other and establish definite proportional position of a pointer or recorder pen at the dispatching station or centralized point.

Another similar system varies the frequency of the signal imposed on the communication channel which is proportional to the measured variable. These methods, in effect, are analog methods as compared to digital methods of transmission. To better define the terms "analog" and "digital" we may compare a meat-market scale, which is an analog machine, to a calculator which in effect is a digital or coding machine. The meat-market scale is approximate; the calculator is exact within the limits of its structure.

With analog telemetering systems, the accuracy of the readings depends upon the uninterrupted pulsing of the communication channel. Noise and signal interruption of any communication system will contribute to inaccuracies in the measured result at the dispatch point. This may result in wiping or oscillation of the pen on an analog telemetering recorder. This instability even though recognized could give considerable concern to the dispatcher and could result in his inability to interpret correctly changes in the telemetered variables.

Reliability . . . Pipeline data are valuable only if the transmitted data are accurate. The usual value of data supplied by analog systems of telemetering is in sharp contrast to the security against false registry of information designed into centralized-control systems which transmit supervisiory control and indications in some form of code steps.

The starting and stopping of machinery as well as the indications concerning the status of the machinery are secured by methods which have been well known in the field for the past 30 to 50 years. They are called by such names as redundancy, three out of five check, message totalizing, answer back, and various code patterns involving the three out of five check principle. These might be described as the "rules of the game," and represent engineering design considerations of considerable proportion.

Experience has shown that this security of data against transmission error is very important in a pipeline supervisory-control system. These safeguards in the equipment make it capable of recognizing correct code patterns from incorrect messages. Applying these same techniques to telemetering of data means we can expect the data obtained from digital telemetering to have the same reliability we have depended upon for many years to start and stop equipment at remote locations, as well as to automatically switch trains and train signals.

Automatic data logging . . . Digital telemetering provides the shortest route from telemetered values to automatic data logging of the information. Data logging in a pipeline is not too different from data logging in the chemical industry. Widespread application of automatic data-logging equipment certainly is taking place in chemical plants and refineries today. Justification for data logging in the pipeline is much the same as in a chemical plant. A few justifications are listed below:

- It frees the dispatcher or monitor from routine

logging of information from recorders, some of which are not easily read with consistency.

- All data are logged simultaneously.
- A short logging time means more data are available for assimilation by the dispatcher or monitor.
- A direct labor saving is obtained in logging of data.
- Data logging places the data in a form which is easily digested by the dispatcher.
- Data for automatic logging are in a form easily applied to computers and other automatic data-handling equipment.

When computers are used to digest pipeline data and automatically provide a control signal to effect changes based on that data, it will be essential that this data be as secure from error as possible. We must guard against error, of course, in our measuring instrumentation. However, we are most vulnerable to error in the transmission of data.

Digital transmission with the safeguards mentioned above assures the maximum reliability in data transmission. In the past, when all data were transmitted orally by telephone, the dispatcher at the central point had logs of information, all about the same as the last information requested. Any inconsistent change was quickly observed by the dispatcher and rechecked orally.

Computers cannot normally recheck the information being fed to them without unjustified expense, and, therefore, cannot differentiate between the data being fed as to their being correct or incorrect. It is absolutely essential, then, that all information be provided in as highly reliable form as can be obtained.

Communications medium . . . The remote-control system or telemetering system can function on any of the usual means of voice communication, be it wire line or microwave. The important consideration is the reliability desired in the communication medium for the type of business operation to be conducted.

This is an individual matter for each company or operation. The important consideration is that after a communication decision has been made, the remote-control and telemetering system possess a degree of reliability and security consistent with the communication and the business operation.

Tank Gaging and P.D. Meters

Although pipeline pressures and flows are important for immediate evaluations, tank levels are the primary dispatching source of information on a closed-system pipeline. Tank levels provide the necessary intelligence to schedule movements of various grades through various lines. They are used in conjunction with customer requirements to establish pumping rates, batch sizes, and scheduled order in which the grades of crude shall be pumped. Positive-displacement meters are another form of this kind of intelligence and can be used from a dispatching standpoint with equal facility.

Tank-gaging accuracy . . . Present tank-gaging methods, on a local basis, are subject to argument as to their accuracy. Some people believe that they are well within ⅛ in. if proper maintenance is carried out to keep them that accurate. Others feel that it is not possible to maintain that accuracy with the kind of construction and equipment used. When it comes to using the presently available tank-gaging equipment for remote transmission of tank gages, the remote indications of level are subject to even further question.

"Present remote transmission systems consist of both types, analog and digital. Those of the digital or pulse type possess resolution to ⅛ in. and represent the type of data most easily transmitted with no loss in accuracy. They are lacking, however, in enough fundamental security checks that are common to all remote-control or supervisory-control systems. Since tank levels mean dollars, if we were to buy and sell oil with them, we would certainly want to be doubly sure of the security of information."

With tank-level data, the same requirements for data security are required as with pipeline pressures and flows and status of machinery. If the industry is ever to buy and sell oil on these remote tank levels, it certainly must be able to look at the remote transmission of the data and say: "This I know to be comparable in reliability to the human ability to read a number and write it down correctly."

Present remote transmission systems consist of both types, analog and digital. Those of the digital or pulse type possess resolution to ⅛ in. and represent the type of data most easily transmitted with no loss in accuracy. They are lacking, however, in enough fundamental security checks that are common to all remote-control or supervisory-control systems. Since tank levels mean dollars, if we were to buy and sell oil with them, we would certainly want to be doubly sure of the security of the information.

Sources of error . . . One of the worst enemies in connection with pulse transmisson over any communication system is impulse noise. This type of noise occurs from such things as lightning, aurora borealis, and more commonly, from manmade sources: It is therefore, desirable to use transmission techniques which minimize the effects of impulse noise.

Such noise impulses, or rather the errors caused by them, give rise to one of the biggest problems in connection with data transmission, particularly when used for accounting or telemetering-control purposes. If impulse noise occurred during a tankage telemetering transmission, it might add a foot or take a foot away from the level. And that would not be a very satisfactory way of doing business.

Security checks . . . One presently available tank-gage remote-transmission system does use one of the basic security checks for data handling, and that is totalizing. If the total number of steps in the code come out to be a definite number of steps such as 24, then the receiv-

ing equipment accepts that tank level as being correct. This does not say that the tank-gage level transmitter is the same as the tank-gage level received because bridging and failure to bridge certain steps in the code could permit the device still to total 24 steps.

A further means of securing this type of tank-level information would be to utilize two of the basic checks employed in coding systems for data security. These are, totalizing plus the checking of each step of the code to determine that if a short or long step was sent, then a short or long step was received. In other words, by answer-back technique, check every step of the code, as well as totalize the number of steps.

This, then, brings the tank-gage level reading up to the same security that is normally associated with starting or stopping a 2,500-hp. electric motor by remote control. With this kind of security to data transmission, anyone willing to accept local-gaging equipment on the tank could certainly accept with full confidence the remote-gage reading of that tank.

Service Pipe Line Co., in connection with its centralized monitoring installations, has installed a commercially available tank-gaging system. But it has the essential modification that each step of the code transmitted is checked to be sure that the same characterization is received as was transmitted. This is in addition to the totalizing check built into the system by the suppliers.

Custody transfer is not involved in the tank levels where this system is employed. However, it is the operating experience with this system that will establish this method of transmission of tank-level determination as a reliable system. The primary measuring equipment on the tank does not fall in a category comparable to the security of the data transmission system. However, this is an area where improvement is technically simple.

P.D. Meters

Remote transmission of positive-displacement-meter readings carry the same requirements as do tank-gage levels. In other words, complete security of data is required and employment of techniques standard in the supervisory-control field again show their merit.

A digital storage and translating unit is shown in Fig. 3.

A digital storage and translating unit accepts pulses from a positive displacement meter. Usually the pulse consists of closing and reopening quickly a contact on the positive-displacement meter for each barrel flowing through the meter. These pulses are totalized and stored in the unit. Battery operation assures no pulses being lost during power outages.

The translating portion of the device converts the pulses into cyclic binary decimal code, which is compatible with the code used for the other telemetered values. No additional translating equipment is required in the centralized-control system to get the data printed out on the typewriter or punched on paper tape.

B.s. and w., gravity . . . It follows if one is willing to accept the positive-displacement-meter readings on a local basis, he will be able to accept with complete security the remotely transmitted positive-displacement-meter reading. In custody transfer of large volumes of oil, gravity and b.s.and w. are measured by sampling the stream during delivery. Temperature can be obtained with available instrumentation in the tank and pipeline temperatures as a check. Present-day techniques of measuring gravity and b.s. and w. do require manual checking. Manual collection of this information does not pose as an obstacle to use of the tank levels in automatic data-handling equipment or in business transactions, if desired.

Although gravity measurement can be made accurately enough for grading requirements with presently available instrumentation, its reliability is difficult to secure. In the case of gravity measurement by sampling a portion of the oil flowing through the line, guarantees that proper sampling occurred are very difficult to make.

If the torque on a float in the center of a tank is used, again sampling becomes the major obstacle. Is the oil around the float the same gravity as in the rest of the tank? This is not only a problem in instrumentation, but a problem of definition and agreement on the part of the oil industry.

B.s. and w. measurements could be made automatically if a common basis is agreed upon that b.s. and w. consists of 80-90 per cent water. If this is agreed, conventional dielectric-constant measuring instruments will meet the requirements of b.s. and w. measurements. If these data were to be remotely transmitted, certainly the same security checks of data transmission would be applicable to them as for the tank levels or positive-displacement-meter readings.

Automatic Pipeline Status

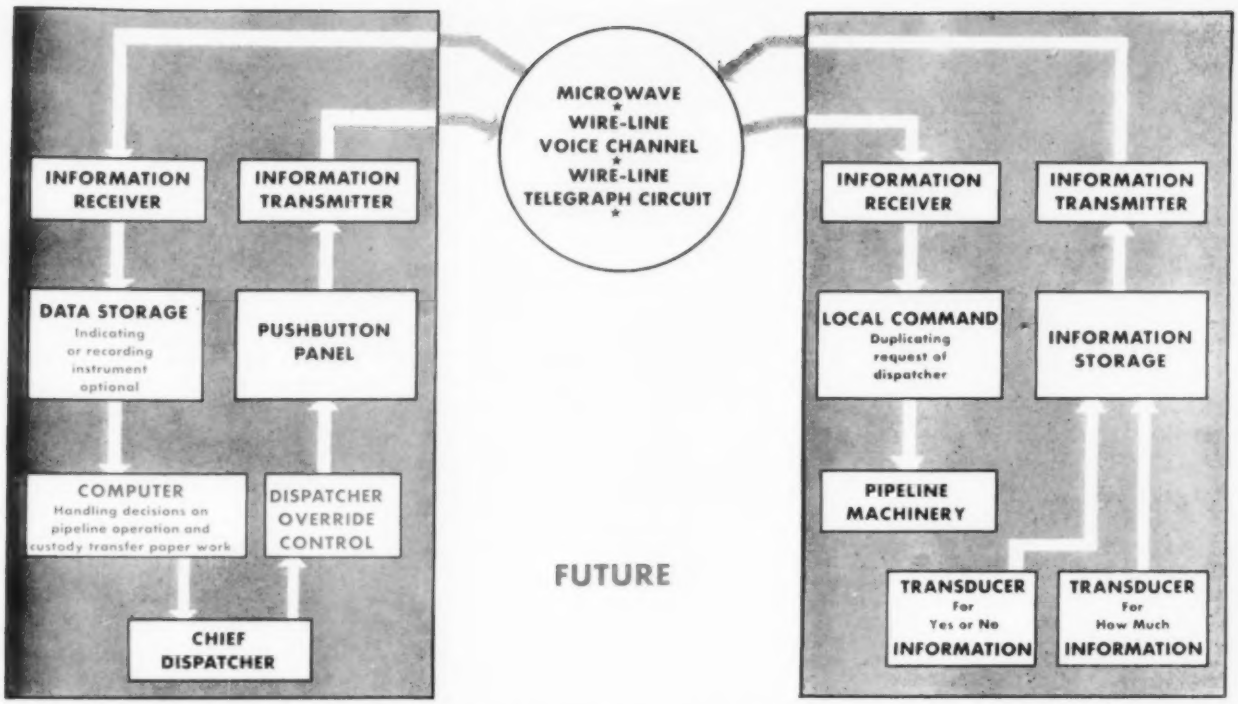
The pipeline of today is certainly not automated to the extent of the purist's definition of automation. Although much instrumentation is being used and machinery is under self-control, the fundamental operation of the pipeline is still a manually controlled operation. Automation techniques of today are merely aids to help people run more extensive operations involving more equipment of larger magnitude.

Automation does not sweep away all of our problems. Automation cannot come up with any better answers than we can produce with brains, eyes, pencil, and paper. It can only help us do many repetitive operations with greater security and with less burden on human beings. Much work is yet to be done before a pipeline will be under full automatic control. Training and education of not only technical personnel, but executives, are clearly required in order to allow companies to grasp the potentials of new automation systems.

Experts in automation are not the people required to revolutionize the industry. Rather it is industry personnel intimately acquainted with the problems of that industry, who need to become familiar with the principles of automation. This must be done in order to see that these techniques are applied in a manner representing the best possible gain for all concerned.

In reviewing the application of computers, feedback systems, and instrumentation in other industries, it is apparent there is no great displacement of personnel as automation techniques come into use.

Available employes can be and are trained to operate and maintain control systems and computers. There of course is a need for specialization, but this does not mean the equivalent to a Ph.D. in electronics, but rather a complete familiarity with one particular phase in a very large wheel. This familiarity is easily attained by applying a willing and energetic mind. It will be these minds that will permit us to progress into automation. We now ask, what will the automatic pipeline of tomorrow mean to us?



THE PIPELINE OF THE FUTURE will have an electronic computer making calculations on pipeline operation and custody transfer and handling many of the decisions. Dispatcher will have override control.

TOMORROW, the day when

"Imagination Changes Into Reality"

PART 2

AGAIN before we can review future technical innovations in tomorrow's automatic pipeline, certain nontechnical considerations must be resolved.

Need to streamline operations . . . Already we are beginning to see certain structural changes in business operations due to automation. Many new things will naturally arise as we move forward technically. To move business operations forward as well, we must recognize the need for a new concept in business organization. Out of this new concept will come new job responsibilities and different job classifications.

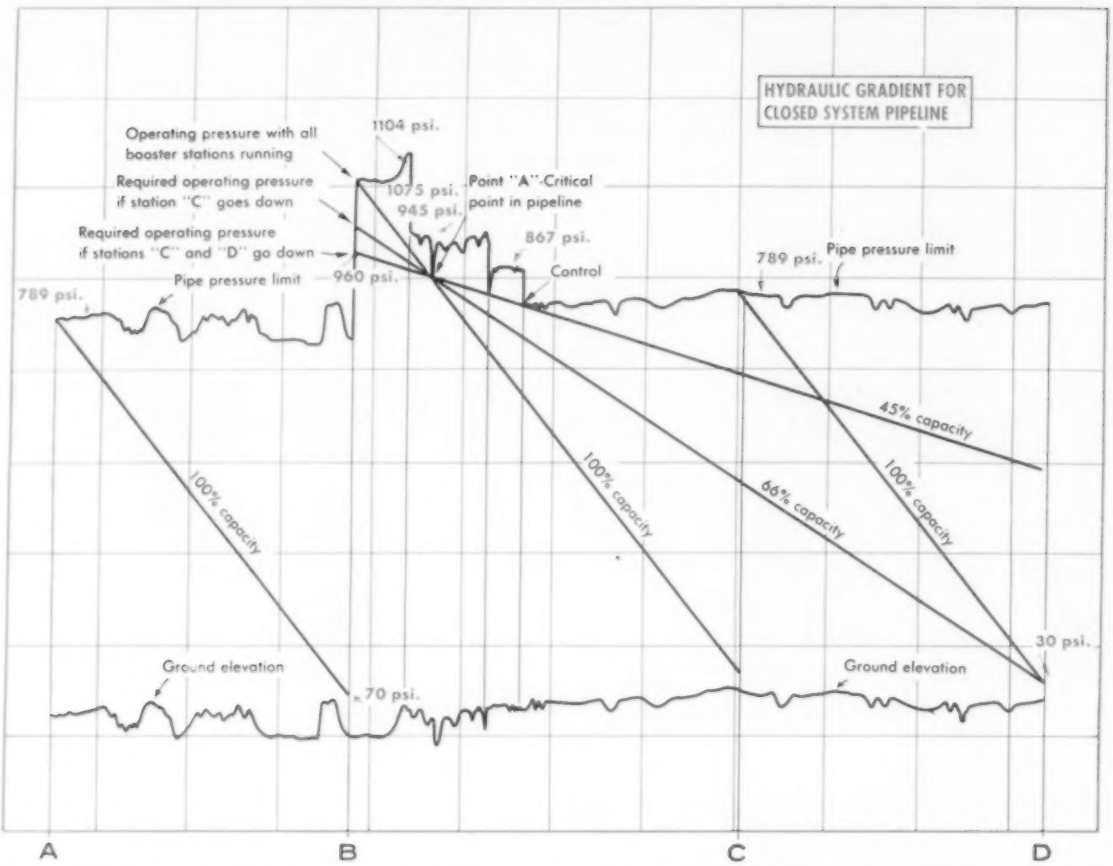
Business will need to make room for a highly integrated engineering program. Automatic pipelines, to be fully automatic, will need to be designed on a systems basis. The discipline imposed by system engineering will follow throughout, to operating and maintenance personnel as well as to management. In short, streamlining operations will be necessary.

Organization, coordination . . . "Automation committees" or "coordinators" must be responsible for evaluating carefully the entire automatic system in terms of its operating problems, its machinery, its users' personalities, and its economics. They will allow the organization to take advantage of the very real payout involved in applying automation.

They will further see that each portion of the equipment is so coordinated that it will readily fit the system it is being applied to. These men must first be intimately acquainted with company operations, and second, familiar with the principles involved in automation techniques.

For example, it would be very uneconomical to provide completely automatic pumping stations where, for other reasons in the operation—such as custody transfer and maintenance—the full attendance of station personnel was necessary. Still, in other places, it may prove very economical to install instrumentation which would free a man to devote his time to more important tasks even though the station is attended. These decisions can be made wisely only from a thorough "systems engineering" approach to the problem.

Another pitfall to be avoided in moving into tomorrow's pipeline is to design a centralized-control system with the thought that, at a later date, a transfer to completely automatic operations can be made, awaiting the operating experience of other people in the industry. When all-out use of automation techniques is started, the system must be designed with the goals firmly in mind in the beginning. Management must recognize that as engineers move forward in the new system, so must operating and maintenance personnel move forward, to assure compatibility.



HYDRAULIC GRADIENT for closed pipeline system. Station B can be operated at much higher pressure provided all of the machinery is running at all unattended stations. Fig. 2.

The big problem in the automation of the future is to apply automation principles in proper combinations to do the job most effciently. This is in preference to the helter-skelter technique of taking everything that is available in its present form and hoping to build a solution to the problem by piling up equipment without thought to efficiency or sound engineering fundamentals.

Right Equipment for Job

In the discussion of the definition of automation, it was described as a new way of doing things. The emphasis is on the way and not on the new. A very good example of this application of fundamental principles in a new way is the application of the American Airlines "reservoir" to the problem of airplane reservations. This is a special-purpose machine doing a special job and has given a good account of itself due to careful planning.

It has been stated by people in the computer field that standard computing machines would not have solved the problem economically, nor would they have been efficient in terms of time. From this example all industries considering automation as well as the pipeline industry can take a lesson. They can recognize limitations and potentials of automatic devices so as to encourage the application of correct equipment to fill their specific needs. Hence we see a need for further education on the part of technical people so they can properly evaluate the potentials and the limitations of automation equipment.

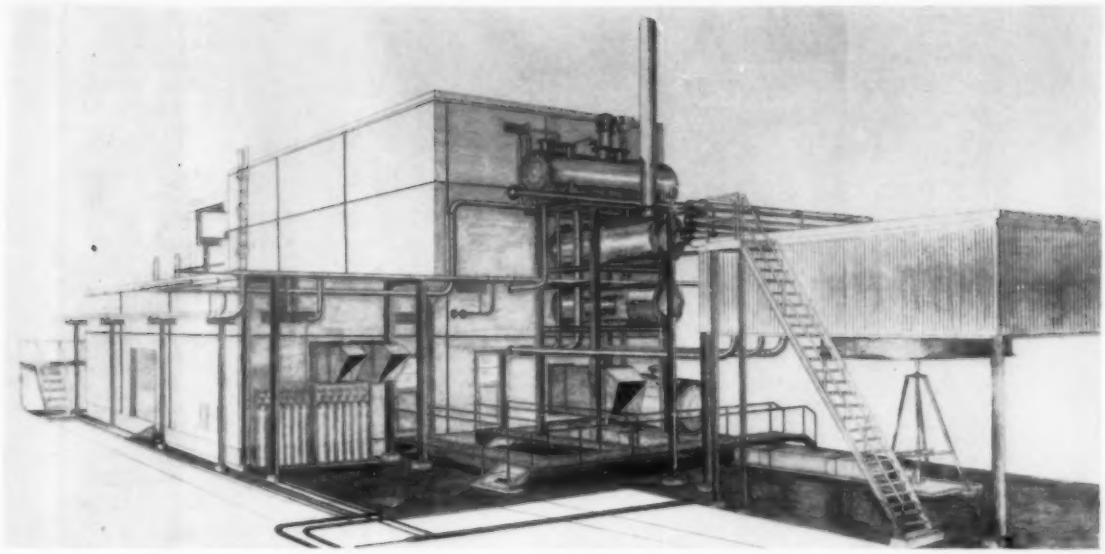
Next a computer . . . Change in the economics of automatic equipment is another consideration that will have much bearing on the rate of progress of automation in the pipeline industry. A review of the computer history of the past 15 years will shed some light on this point. New components in the electronic industry have opened the way to a genuine bounty of small, economical, and more efficient labor-saving devices.

The first digital computer in 1944 filled an entire room and cost on the order of a million dollars. Today a digital computer of equal capacity will fit in a packing case and sells for $150,000 to $200,000. At some time in the future, computers capable of doing a big job will be reduced to the size of a hatbox and, with a fisherman's optimism, perhaps sell for several hundred dollars.

So, somewhere between today's cost of $200,000 and the "sometime in the future" cost of several hundred lies the economical application of computers in pipeline operation. Putting computers in pipeline operations gives birth to a completely automatic pipeline, which we will discuss under technical considerations.

Automatic Feedback

It is putting the computer in pipeline operations of today which will permit automatic feedback to enter the picture. This completes the central loop, and our pipeline becomes truly automatic.



SPECIALLY DESIGNED SATELLITE STATIONS for gas pipelines are to be built from the ground up, with remote operation in mind. A prime design consideration is safety. If anything goes wrong, the worst that happens is the station shuts down.

A beginning . . . Although no extensive use of automatic feedback in pipeline operations is being made today, even where remote control is practiced, a step in this direction is being taken. The following example, although it is only a beginning, has all of the fundamental characteristics of feedback control in it. And is based upon computer techniques, albeit they are simple.

As shown in Fig. 2, it can be seen that station B can be operated at much higher pressure provided all of the machinery is running at all unattended stations, A, B, C, and D. If any of the machines at Stations C and D shut down, the allowable pressures on the pipe out from Station B will be exceeded and will probably break the line. What is required is automatic resetting of control set points or operating pressures at Station B.

This is based upon taking information at a central point concerning which units are running and which units are not running, and using this information to establish a control action to regulate what discharge pressure is to be permitted at Station B. In this case the relays indicating the position or status of each pumping unit at each unattended location are provided with spare contacts. They can be used to determine when a control signal is to be sent out over the supervisory-control system to effect a transfer of the local control equipment from one operating pressure to a lower operating pressure.

Here security against communication-circuit failure can be obtained by reducing the pumping rate at Station A which, in effect, decreases automatically the discharge pressure at Stations B and C. When communications are restored, the flow rate at A can be increased.

The ultimate extension of the principles of feedback, of couse, requires much more complicated computing than this. It is of the same type, however, and is more involved only because there is so much more work done. The principle would be the same. With proper operating information—that is, tank levels, flow rates, and batching-sequence information—the scheduling of all crudes could be coordinated through a computer. The customer requirements and customer planning could be based upon their computer's advice as to the schedule required.

Pipeline hydraulics could be monitored automatically in two ways:

. . . **Flow rates** in and out of a pipeline can be compared very easily in a computer.

. . . **Throttling losses** could be measured and compared to a programed pattern for that pipeline predicated on the pumping machinery pump differentials available at each location and the hydraulic requirement dictated by batching and flow rates.

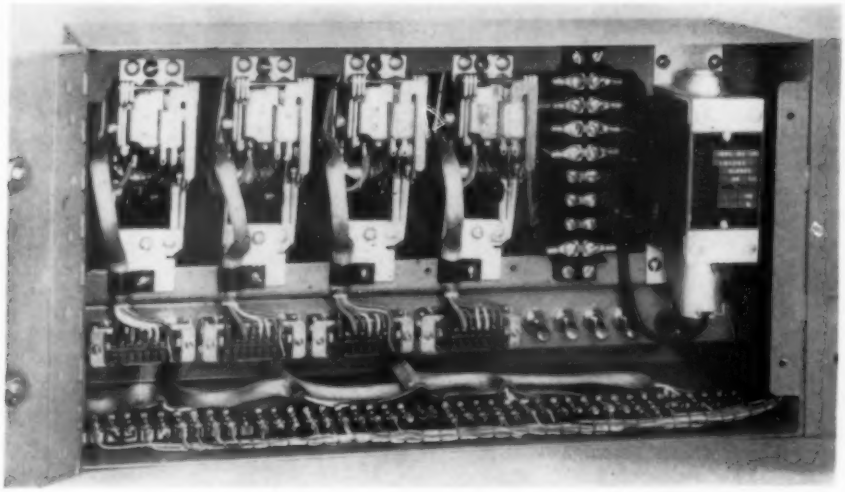
An answer as to what machinery should be running or what rates should be maintained could be provided automatically. And the loop could be completely closed by sending control codes out to shut down or start up machinery as well as establish operating pressures as required by that closed-system pipeline.

This or any other computer cannot do a great deal more than we can do now with people. But it can do it more efficiently, with a minimum of errors, and do it day and night without ever becoming tired or despondent. Job dissatisfaction and extensive training of new personnel are never considerations for automatic computing equipment.

Single and multiple-pipeline operations involving a number of satellite stations coupled with batching of many crudes under varying flow rates certainly present enough variables to keep a computer running merrily. Digital telemetering presents an ideal first step in the direction toward computer-controlled pipeline operations.

A computing machine is of no help if all of the data fed to it must be verbally transmitted, manually written down, and manually punched into the machine and visually read off the machine as an answer and a verbal decision sent out as to the required change. All data must be put in a form which will permit the machines to handle it all the way through and at a speed consistent with the requirements of the pipeline system.

Complete security of data transmission assures giving the computer food that is fresh and untainted. This will certainly help prevent a sick answer. With the abil-



DATA STORAGE on the future pipeline will not require indicating or recording instruments. This unit will be connected directly to a computer. Fig. 3.

ity to have complete security of all telemetered data, integration of these data into custody-transfer operations and automatic accounting data-processing machines is very easily accomplished.

Future Tank Gaging, P.D.-Meter Data Handling

As mentioned earlier, the instrumentation available for present tank level measurement is in a questionable category as to reliability. Economic considerations are certainly important reasons for this situation. It is here, however, where a systems engineering approach may permit a solution for the benefit of the entire automation program.

If coded signals, as available today, were to be integrated into centralized computing equipment, translating equipment would be required for each different type of gage on the market. If this translation were done in the field at each tank with the cost of translation and storage amounting to over $1,000 for each translator, the cost would be prohibitive.

Standardization need . . . When a company installs one type tank gage, the problem of integration of gaging systems precludes its ever using any other type economically. Even the digital systems are different for the various manufacturers of tank gages and their code patterns are not similar to other code patterns for pressure and flow data.

If agreement could be reached between the oil industry and suppliers on the type of code pattern required for remote transmission of tank gage data, it would be possible for the user to effect savings in translating, receiving, and computing equipment when used together. This in turn would permit opportunity for the user to spend more money on primary measuring instrumentation. This type of standardization would provide economic incentive for obtaining a primary-measuring element consistent with the accuracies and reliability desired.

A systems engineering approach is definitely required here. In addition to a standardized code-pattern configuration, an agreement on the required data-security safeguards would be very desirable. The oil-transportation industry should set up this standard based upon the usual security practiced in business accounting where money figures are used in machines.

This does not require things to come out to the "drop" of product. But suppose that the industry is willing to accept ⅛ in. as close enough measurement on a tank level. Then measuring and remote-transmission equipment should absolutely guarantee that the tank level obtained will be remotely transmitted and recorded and used in the machine with the same resolution and accuracy as was obtained from the local tank gage. That is, within ⅛ in.

If the oil industry would establish this safeguard requirement of data from tank gages, the suppliers would be provided with a standard to shoot at in all of their designs, and it would simplify their engineering approach to the problem. It would concentrate efforts in one direction and a solution acceptable to all could be achieved at minimum cost to the entire industry.

Positive-displacement-meter readings are another piece of information which falls in the same category as tank gaging, however, the translation of pulses to a particular code pattern is not difficult. The security of remote transmission of the data should be the same as for tank gages, if used for custody transfer.

Should I.S.A. Speak Up?

A group which is very familiar with automation techniques, and contains representatives from the oil industry as well as the instrumentation manufacturers, is the Transportation Committee of the Instrument Society of America. Their recommendations in terms of a "systems engineering" approach to this problem would be a real contribution to the oil-transportation industry.

Conclusion

In conclusion, a word of caution. The tremendous fascination linked with the advantages of automation tend to make engineers and scientists move too far and too fast technically toward the completely automatic pipeline. As we mentioned before, one of the pitfalls of this new way of doing things is the mental attitude of the uninitiated. This problem has prevented two things:

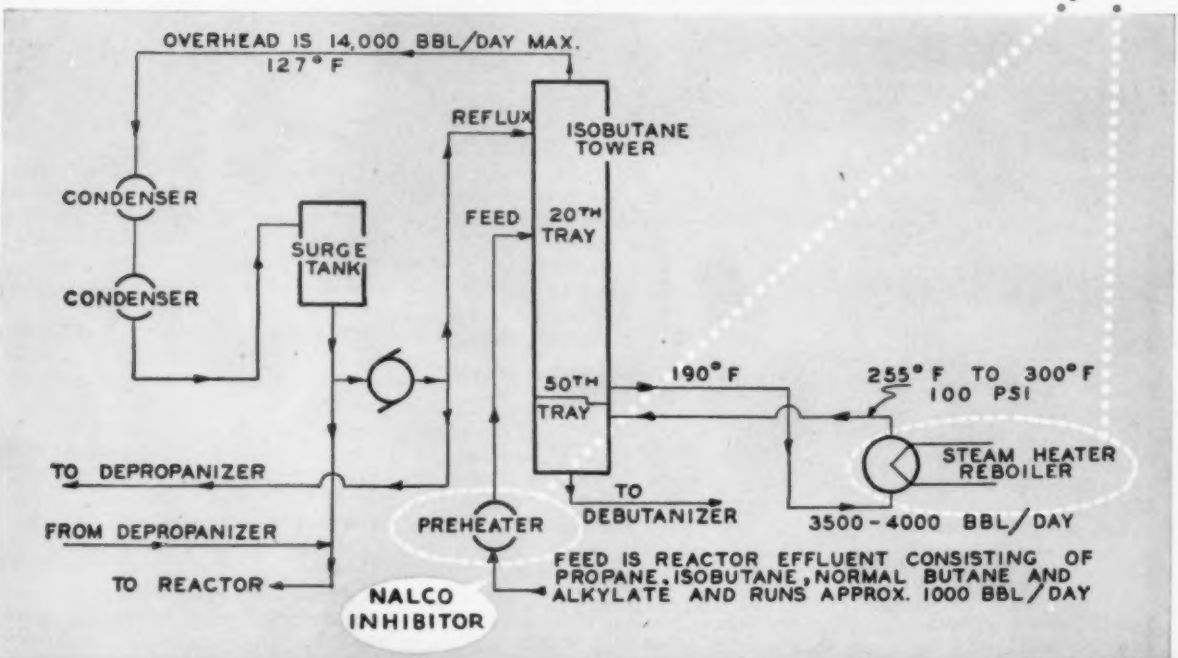
1. Proper standards for equipment.

2. Adequate training of all personnel.

Mental attitude has made industry reluctant to reorganize operations to even adequately meet automation in these infant stages. Scientists and engineers must be realistic. They must remember that if they lead their company into automation, it is their responsibility to see that communications between them and management are such that the company moves into automation efficiently. Dual responsibility of engineers and management is necessary to see that all essential changes in business organization, personnel psychology, and technical advances are made together, and that none lags behind. Tomorrow is the day we look to changing imagination into reality. **End.**

Nalco INHIBITORS GET RESULTS AT THESE TYPICAL TROUBLE-SPOTS

IN AN H_2SO_4 ALKYLATION SYSTEM



THE PROBLEM	THE TREATMENT	THE RESULTS
1. *Corrosion* in the preheat exchanger of the isobutane tower. 2. *Fouling* with ferric sulfate and hydrolysis products of esters of H_2SO_4 in the reboiler of the isobutane tower.	Nalco Inhibitor fed to the isobutane tower at first month rate of 20 ppm with subsequent reduction to 10 ppm.	Reboiler pressure drop held to 25-28 psi. No decrease in reboiler coefficient. No problem of corrosion or deposits during more than a year of operation with Nalco treatment.

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PROGRESS REPORT

How Are Turbodrills Performing?

Briefly, penetration rates are faster, but bit footages are lower. Graphs indicate conditions necessary for reduced cost of drilling

By J. A. Mitchell

DRESSER'S turbodrills have now logged over 13,000 ft. of hole in the first phase of a planned evaluation program. This program is directed toward field testing of various sizes and types of turbodrills for the purpose of establishing operating procedures and verifying turbodrill characteristics in American drilling conditions.

Hole sizes have ranged from 7⅞ to 17½ in. using available turbodrill sizes of 6⅝, 8½, 9¼, and 10¼ in. The major problem in development is poor bit performance.

Conclusions from drilling results are:

- Penetration rates exceed those of comparable rotary drilling. The increase has ranged from 1½ to 5 times with most cases ranging from 2½ to 3.
- Bit footages are lower than with the rotary, especially for bit sizes less than 9⅞ in. Footages for larger bits have been from 70 to 100 per cent of rotary. For smaller bits footages have been as low as 30 per cent of rotary.
- Under some conditions conventional rock bits can transmit the turbodrill's power and speed successfully, and lower drilling costs result.

Author is with Dresser Industries, Inc., Dallas. Paper presented at the spring meeting of the Rocky Mountain District of the A.P.I. Division of Production, Casper, Wyo., under the original title, "Turbodrill Developments."

Recent Turbodrill Developments

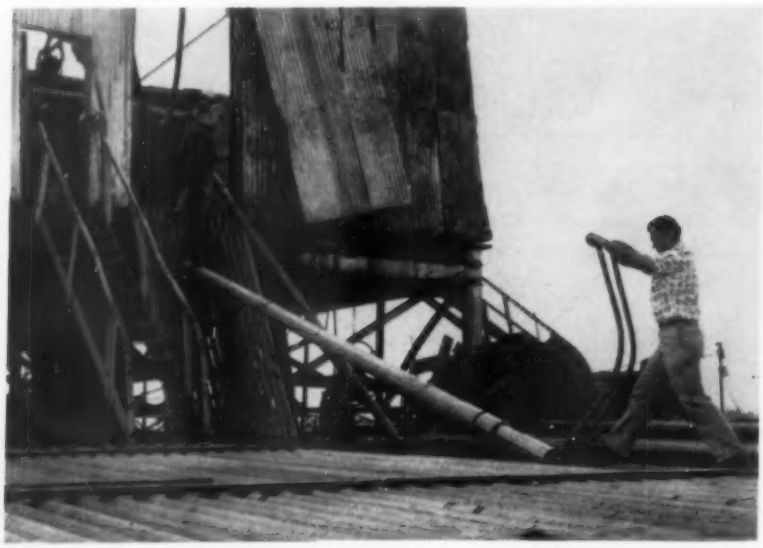
Last October, Dresser Industries acquired 40 turbodrills of several different types from the Russians, and 2 turbodrills from the French hydraulics firm, Establissement Neyrpic. Since that time we have acquired two other turbodrills from Neyrpic. With these tools we have drilled one test hole 2,700 ft. deep, in the city of Dallas, and have conducted tests under actual field drilling conditions in parts of 15 oil wells*.

What is a turbodrill? . . . In general terms a turbodrill is one specific type of a large class of earth-boring devices known as down-hole prime movers. In a down-hole prime mover, power is generated or packaged at the surface and transmitted to the bottom of the hole by some means. There a motor or engine converts the transmitted energy into useful work against the formation.

In the turbodrill the engine is an axial-flow hydraulic turbine. Hydraulic power, generated at the surface in the mud pumps is transmitted in the mud stream through the drill string to the bottom of the hole where the turbine converts this hydraulic energy into shaft horsepower which, through the bit, performs useful work on the bottom of the hole.

The outstanding advantage of bottom-hole prime movers is quite obvious. This is the elimination of the necessity for a rotating drill string with its inherent power loss as the result of friction against the walls of the hole.

*As of May 27, 1957.



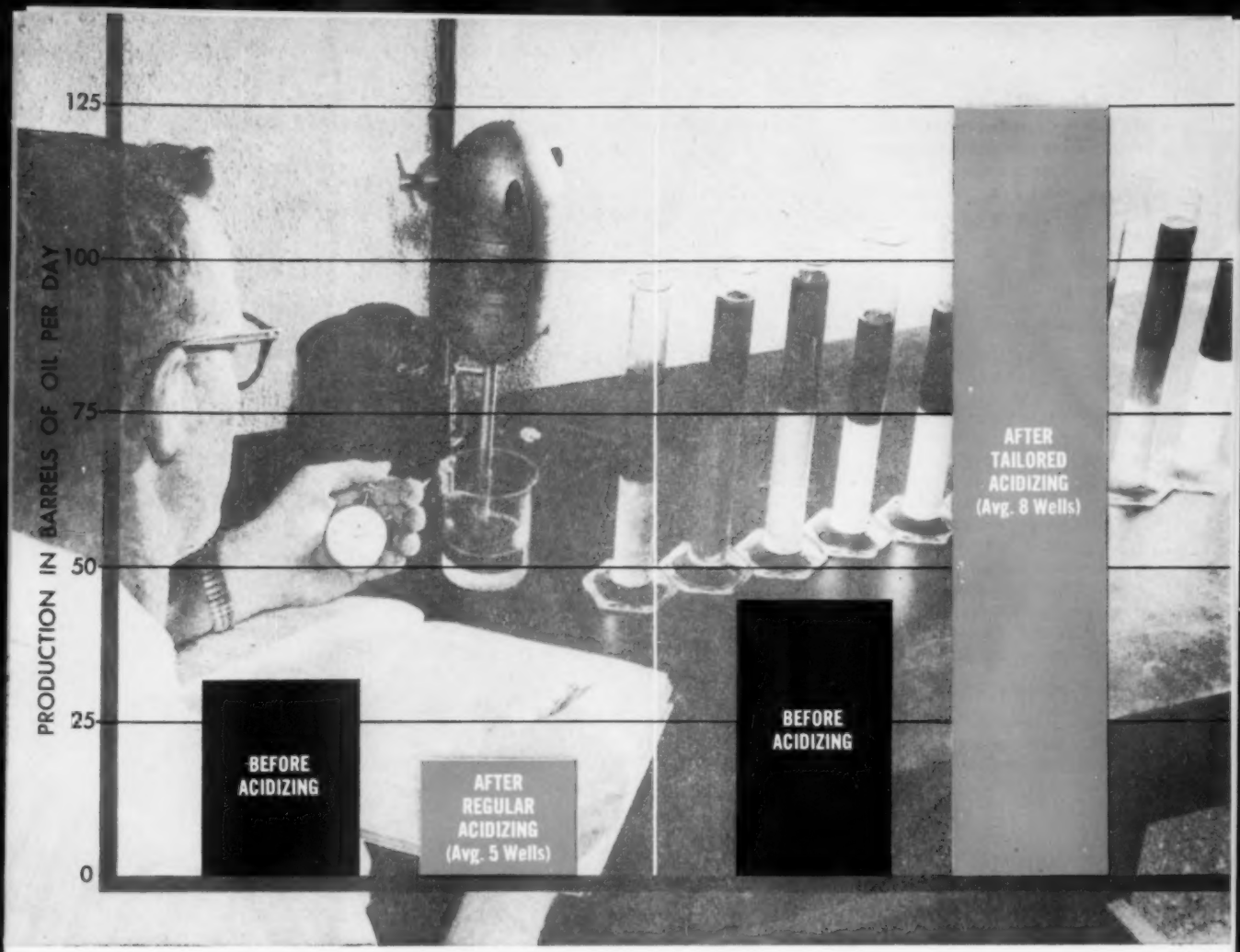
HANDLING THE TURBODRILL is very similar to the handling of a drill collar, which is shown here. Fig. 1.

Why the interest? . . . A number of answers might be given to the question of why the interest in turbodrills. Anyone who takes a look at the cost of drilling wells will immediately give the answer "to lower the cost of drilling."

Last year the American Association of Oil Well Drilling Contractors conducted a survey[1] on the cost of drilling which showed:

- The cost of rotary drilling has doubled since 1941.
- The rate of penetration is up 88 per cent since 1941, but has remained static for the last 3 years
- The average time to drill a well has decreased since 1941, but this, too, has remained static for the past 3 years.

More power . . . Even though the primary interest in the turbodrill is to lower the cost of drilling, one might logically ask why it should. The answer is that the turbodrill can make available at the bottom



"BLIND" ACIDIZING CAN BACKFIRE

Case In Point: McClosky Limestone

This formation tested 93 to 99 per cent soluble in acid, yet regular acid treatments often reduced, rather than increased, production. The obvious conclusion was emulsion block, but ordinary emulsion breakers were not effective.

Dowell engineers obtained cores and formation fluid for laboratory investigation. The result: it was discovered that an unusual emulsion was being formed during acidizing. The laboratory recommended a special addition agent which was mixed with the acid to prevent emulsion. Immediately, results of treatments with this Dowell "tailored acid" became consistently successful, as the bar charts show.

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of the hole more power than the rotary—and do this economically.

The approximate bottom-hole powers which can be produced by cable tools, rotary, and turbodrills in a 12¼-in. hole are as follows:

Method		Bottom-hole Horsepower
Cable tool (3,300-lb. tool; 50 s.p.m)		26
Rotary (from limited experiments)	0- 3,300 ft.	40-70
	3,300- 6,600 ft.	30-50
	6,600-10,000 ft.	20-40
Turbodrill—Maintained to almost any depth		200-400

The turbodrill, with its ability to produce some 5 to 10 times the power of rotary, undoubtedly has the capability of increasing penetration rates over the rotary more than the rotary increased over the cable tool.

Penetration rate, of course, is not a function of bottom-hole horsepower alone. In the final analysis penetration rate is a function of how effectively the drill bit applies the available power to the formation.

Modern Turbodrills

Several types of turbodrills are manufactured to accommodate various drilling conditions or operations. these are:

Model	No. of Stages	Remarks
Standard (T12M3)	100	For normal drilling
Sectional (compound) TC4)	187-240	Two to three turbine sections fastened together to increase torque.
Core drills (KTD)	87	Has a hollow shaft to accommodate a wire-line core barrel.
Stub (about 10 ft. long)	30-40	A short model for use in directional drilling.

For our developmental work we have several sizes of each model except the short, directional tool.

Except for the sectional (TC4) drill the purpose of each model is quote obvious. The following fundamental turbine relationships will aid in understanding the purpose of the sectional unit:

1. Turbine speed is proportional to flow rate.
2. Turbine torque is proportional to (flow rate)^2.
3. Turbine pressure drop is proportional to (flow rate)^2.
4. Turbine power is proportional to (flow rate)^3.

Also, in the multistage turbodrill turbine, the total power output is directly proportional to the number of stages.

Two important uses of the sectional (compound) model are now apparent. These are:

1. Under conditions where it is desirable to drill at reduced flow rates, power output is maintained at a sufficiently high level because of the increased number of stages.
2. Where it is desirable to drill at a lower rotational speed, speed reduction can be accomplished by reducing the flow rate: again without a serious loss in power.

Certain characteristics of standard and sectional tools, such as length, weight, required flow rate, etc., are shown in Tables 1 and 2. We also have 10¼ and 8½-in. core drills. Each size cuts a core approximately 2 in. in diameter. They have only 87 stages; and when operating at flow rates comparable to the standard 100-stage unit, require some 150 to 200 psi. less pressure.

Drilling-rig requirements . . . At the present time no major changes in rig design are indicated. Handling the tool is very similar to handling a drill collar (Fig. 1). For any given flow rate, pump pressure and horsepower must be increased over that required by the rotary. This is quite obvious inasmuch as the turbodrill requires additional pressure, and sometimes flow rate, to operate properly.

In order to reduce pump requirements, hydraulic friction losses in the drill string must be kept to a minimum. This, of course, indicates the use of large i.d. drill pipe and tool joints.

One other rig change is desirable if the turbodrill is to reach its full potential. In relatively soft drilling the time involved in making connections becomes a serious limitation. For such situations there must be developed a means for feeding the drill string into the hole more rapidly.

Turbodrilling Techniques

In general, good rotary practice is also good turbodrilling practice. Although it is unnecessary to rotate the drill string when using the turbodrill, factors such as maintenance of good hole condition usually require that the pipe be rotated, at least slowly. In actual practice the rotary table is turned to the right as slowly as possible, or the rotary is simply unlocked and allowed to rotate backwards.

The latter is good practice when the hole is deep enough so that the pipe drag against the walls supplies the necessary backup torque. When using this method the pipe is rotated backwards from the bottom of the hole by the turbodrill at speeds of about 10 to 20 r.p.m.

Weight on the bit is observed at the surface on the conventional weight indicator and is applied and maintained exactly as with the rotary.

Operation . . . Some idea about the actual operation of the turbodrill may be had from Fig. 2. This is a performance characteristic curve for a Russian 10¼-in. o.d., 100-stage turbodrill. The drilling fluid is water at a flow rate of 780 g.p.m. From this figure it is seen that the turbine

TABLE 1—DESIGN CHARACTERISTICS OF RUSSIAN STANDARD TURBODRILLS (T12M3, 100-STAGE; OPERATING ON WATER)

Size O.D. (in.)	Approx. Length, (ft.)	Approx. Weight, (lb.)	Flow-rate Range, (g.p.m.)	Pressure Drop (psi.)	Design Speed, (r.m.p.)	Horsepower, Design Conditions
10¼	29	5,210	790	665	610	200
			1,080	1,200	830	500
9¼	30	4,260	710	600	630	180
			950	1,075	840	420
8½	29	3,520	634	570	645	120
			870	1,085	887	310
6⅝	28	2,350	395	451	660	46
			555	884	924	127

TABLE 2—DESIGN CHARACTERISTICS OF RUSSIAN SECTIONAL (COMPOUND) TURBODRILLS (TC-4; OPERATING ON WATER)

Size O.D. (in.)	Approx. Length, (ft.)	Approx. Weight, (lb.)	Flow-rate Range, (g.p.m.)	Pressure Drop (psi.)	Design Speed, (r.m.p.)	Horsepower, Design Conditions
10¼	52	9,560	600	760	465	177
			790	1,315	612	400
8½	51	6,930	510	724	515	120
			680	1,310	690	290
6⅝	50	4,450	317	545	530	45
			475	1,230	795	150
5	45	2,220	126	490	585	17
			240	1,753	1,100	114

Note: The 5-in. size has 240 stages; all others have 187 stages.

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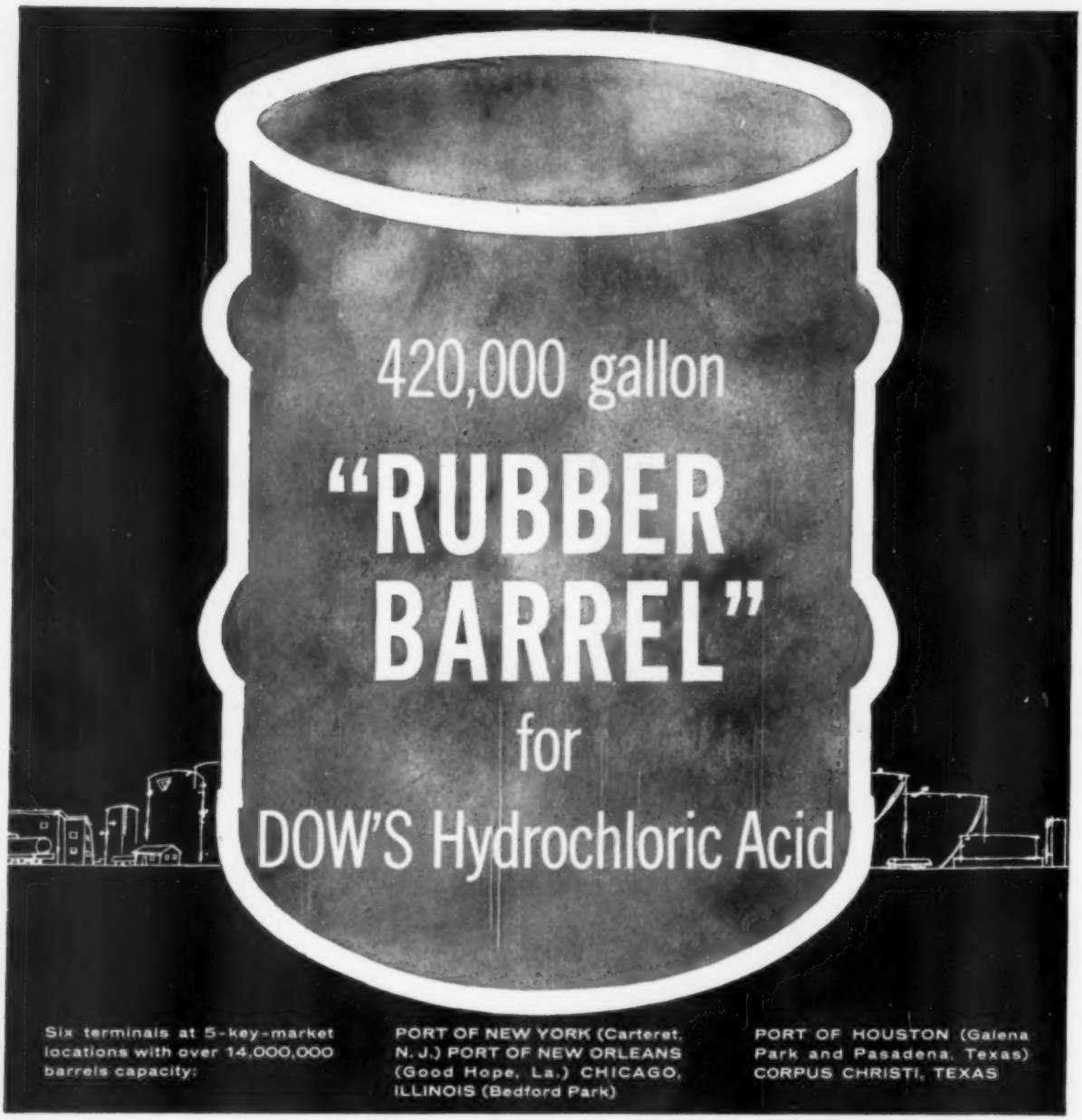
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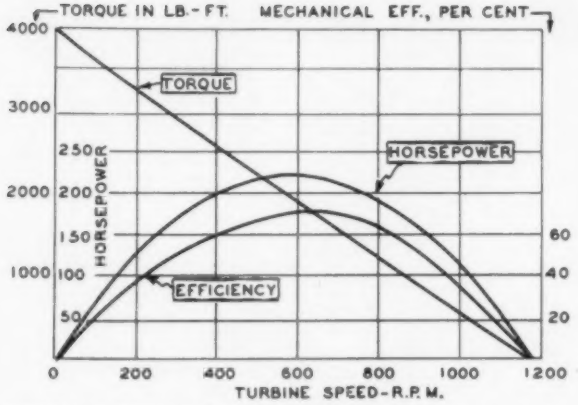
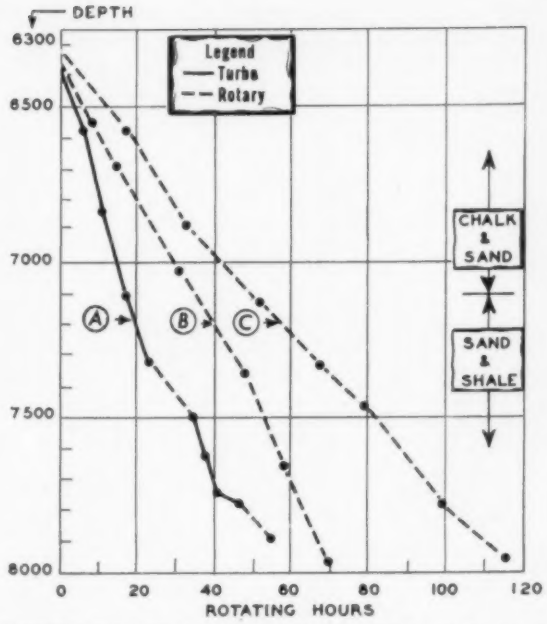
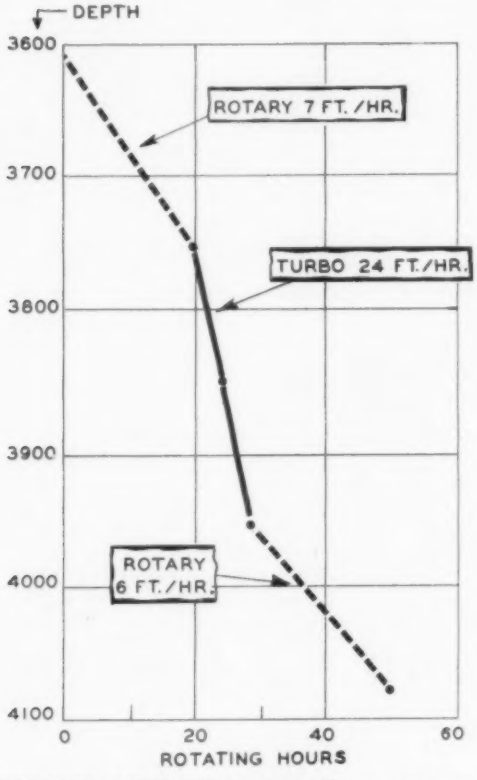


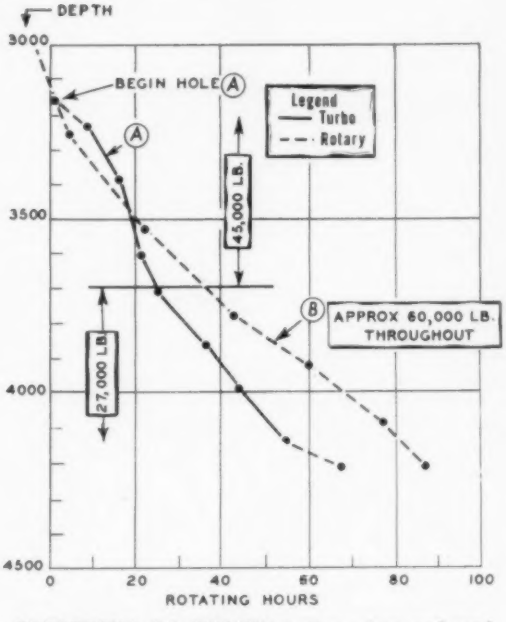
TYPICAL PERFORMANCE CURVE for 10¼-in., 100-stage turbodrill, using 780 g.p.m. of water as drilling fluid. Fig. 2.



TURBODRILL COMPARED WITH ROTARY in 8½-in. holes, drilling in soft chalk. Fig. 3.



DRILLING COMPARISON, turbodrill vs. rotary, in opening 11-in. hole to 17½ in. Formation was lime and dolomite. Fig. 4.



TURBODRILL VS. ROTARY in lime, chert, and sand formations, Permian basin of West Texas. Hole was 12¼ in. Fig. 5.

is a variable-speed device, and for the given flow rate the turbine speed ranges from zero in the stall condition to about 1,200 r.p.m. in the no-load condition.

The horsepower curve is essentially a parabola. Maximum horsepower is developed at 600 r.p.m., which is about halfway between the no-load speed and the stalled condition. Torque increases rapidly from zero at the no-load speed, i.e., with bit off bottom, to a maximum at the stalled condition. The efficiency curve is very similar to the horsepower curve, in that the maximum efficiency occurs at about midrange of the turbodrill speed.

As weight is applied to the bit, the turbine begins to slow down, because more torque is applied to the shaft. Usually, sufficient weight should be applied to the bit to cause the turbine to run at or near maximum power output. The optimum operating-speed range seems to be on the low-speed side of the maximum horsepower output. When operating in this range, more weight is applied to the bit and the turbine runs at a slower speed with the result that penetration rate and bit life are usually increased.

Current Results

When the turbodrills arrived in this country last October, there were

several unknown factors relating to the prospects for economic success in the United States. After the limited field work which has been accomplished, the prospects are encouraging; however, some problems have developed. These must be solved before turbodrilling becomes economical on a large scale.

The major problem is bit performance. Bit footages with the turbodrill are lower than with the rotary. This is especially true in bit sizes smaller than 9⅞ in. To some extent this was expected because of the greatly increased speed and horsepower of the turbodrill and because smaller bits are not as rugged, proportionately, as are larger ones. In the larger sizes, bit footages have ranged from about 70 to 100 per cent (or more) of rotary. In the smaller sizes, bit footage has been as low as 30 per cent of rotary and has ranged up to 80 to 100 per cent in some cases.

In discussing field-test results at this early date, considerable caution and open mindedness must be observed. Field trials have been conducted in parts of 12 wells. For various reasons only 4 out of these 12 are considered to be highly significant. A variety of conditions have been encountered while drilling in soft shales, salt, anhydrite, hard lime, chert, and sand and shale. In the first 10,500 ft. of drilling, 87 bits were run. By May 27, 1957, 108 bits were run.

Rate increase . . . In all but a few bit runs, penetration rates have exceeded those of comparable rotary. Depending upon drilling conditions, this increase has ranged from 1½ to 5 times rotary with the majority of cases ranging from 2½ to 3. Although bit footages have been low in many runs, drilling economies can be obtained if penetration rate is high enough to offset low bit life.

In the following three examples, an estimate of comparative drilling costs has been made. A reasonable charge, which is probably on the high side, has been included for the turbodrill. The cost estimates were calculated by the well-accepted equation which includes costs of bits and rig time while drilling and making round trips.

Case 1 . . . Fig. 3 is a set of penetration-rate curves which compare the performance of the turbodrill with rotary in the same hole (curve A) and with rotary in two offset holes (curves B and C). These are 8½-in. holes in relatively soft chalk, sand, and shale. The total test interval was from 3,395 to 9,400 ft. Twenty turbodrill runs and twelve rotary runs were made. The graph includes the interval from 6,300 ft. to 8,000 ft.

The turbodrill's rate of 38 to 45 ft. per hour is 2.7 to 3 times faster than the rotary's 14 ft. per hour in the same hole. When compared with the offset holes, the turbodrill rate is 2 to 3 times faster in the interval 6,300 to 7,325 ft., and is approximately 1.3 to 3 times the offset rotary rate in the interval below 7,325 ft. Turbodrill bit footage is approximately equal to rotary footage in the same hole (A), approximately 95 per cent of the rotary-bit footage in hole C; but only 62 per cent of the rotary bit footage in hole B.

In the interval down to 7,325 ft., turbodrilling cost approximately 5 per cent and 10 per cent less than rotary in holes B and C, respectively. In the same hole, at the penetration rates and bit footages shown, the turbodrill cost approximately 20 per cent less than the rotary.

Although the entire test was not highly successful from an economic standpoint, it was technically successful and sufficiently encouraging to warrant further work in drilling softer formations.

Case 2 . . . Fig. 4 compares rotary and turbodrilling under conditions which are more suitable for turbodrilling. This well was located near the south end of the Central Basin platform in West Texas. Although the operation of opening a hole from 11 in. to 17½ in. may be somewhat specialized, it did provide a good test for the turbodrill's power output and drilling performance.

In the interval shown (3,600 to 4,100 ft.) the turbodrill's penetration rate of 24 ft. per hour is 3.7 times the average rotary rate of 6.5 ft. per hour. The turbodrill bit footage was 81 per cent of the average footage attained by the rotary. Under these conditions of relatively high bit footage and penetration rate, the hole drilled by the turbo cost 27 per cent less than that drilled by the rotary. In this high-cost operation, the savings amounted to several dollars per foot.

Case 3 . . . Fig. 5 shows penetration rate curves for turbodrill vs. rotary, drilling 12¼-in. hole through lime, chert, and sand in the Permian basin of West Texas. Curve A is the turbodrill test hole and curve B is an offset rotary hole approximately 1 mile away. This was fullhole drilling, through fairly constant lithology, and is considered to be quite representative of the turbodrill's capabilities. As in so many field tests, however, an uncontrollable variable was present. Crooked-hole conditions are prevalent in the test-hole locality.

At the intermediate casing depth of approximately 4,200 ft. deviation is usually 3½° to 4°. At 3,700 ft. in the test hole, weight on bit was reduced from 45,000 to 27,000 lb. to avoid increasing deviation from the 2° then present. On curve A this is clearly evident as a decrease in penetration rate. In the offset hole, weight on bit was maintained at approximately 60,000 lb. Deviation at 4,200 ft. was 2° in the test hole and 3° in the offset.

Penetration rate, bit footage, and resulting drilling costs were very much in favor of the turbodrill in the test hole. From 3,195 to 3,382 ft. (the upper part of the hole shown on the graph), turbodrill bit footage was 132 per cent of rotary, penetration rate was 3.6 times rotary, and the cost per foot was 57 per cent less than rotary. In the lower portion of the test hole (4,038 to 4,200 ft.), turbodrill bit footage was 122 per cent of rotary, penetration rate was 2.8 times, and cost per foot was 31 per cent less than rotary.

When comparing the turbodrilled interval (3,260 to 4,127 ft.) with the offset rotary hole, the story is less favorable. Here the turbodrill average bit footage is approximately 60 per cent of rotary; over-all penetration rate 2 times that of rotary; and cost per foot only 5 per cent less than rotary. It should be remembered, however, that in the turbodrill hole, weight on bit was reduced to 27,000 lb., whereas greater weight on bit was maintained in the offset rotary.

Future use . . . These figures and graphs are presented to illustrate that there are conditions under which the turbodrill with conventional rock bits can reduce the cost of drilling. They are not intended to imply that turbodrilling is ready for the market under all conditions. Generally, in the softer formation where rotary penetration rates and bit footages are high, turbodrilling is less advantageous. The harder formations seem to be more susceptible to penetration rate increases by the turbodrill, and when turbodrill bit footages are sufficiently high, turbodrilling definitely has an advantage.

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2. Tiraspolsky, W.; Rouviere, R.; and Charé, J.: Drilling with Subterranean Motors and the Development of Turbodrilling, Revue De L'Institut Francais Du Petrole, Aug. (1955).

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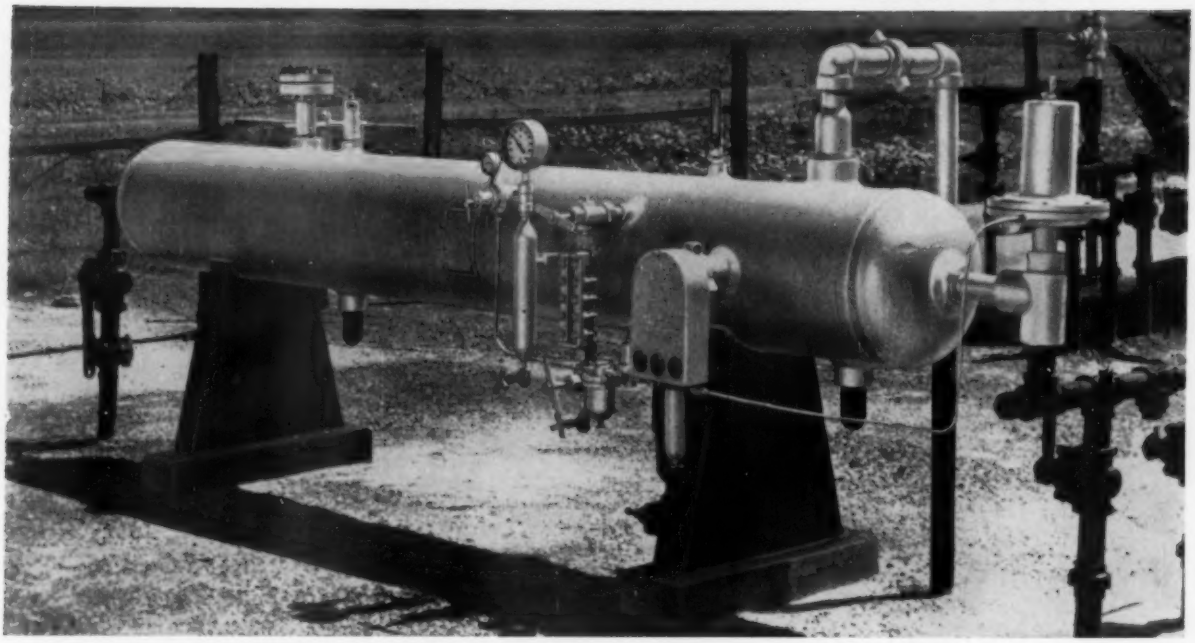

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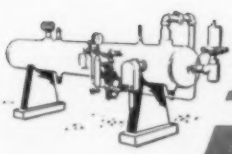

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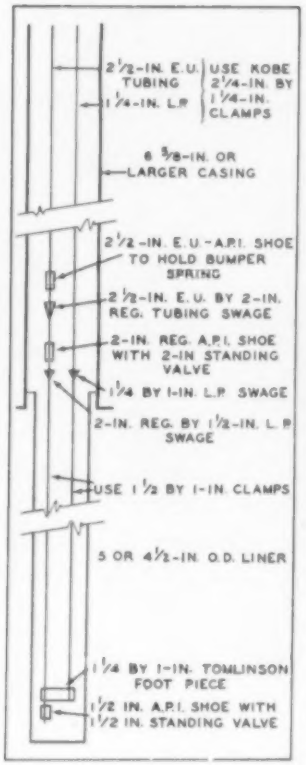
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USE KOBE 2¼-IN. BY 1¼-IN. CLAMPS
6 ⅝-IN. OR LARGER CASING
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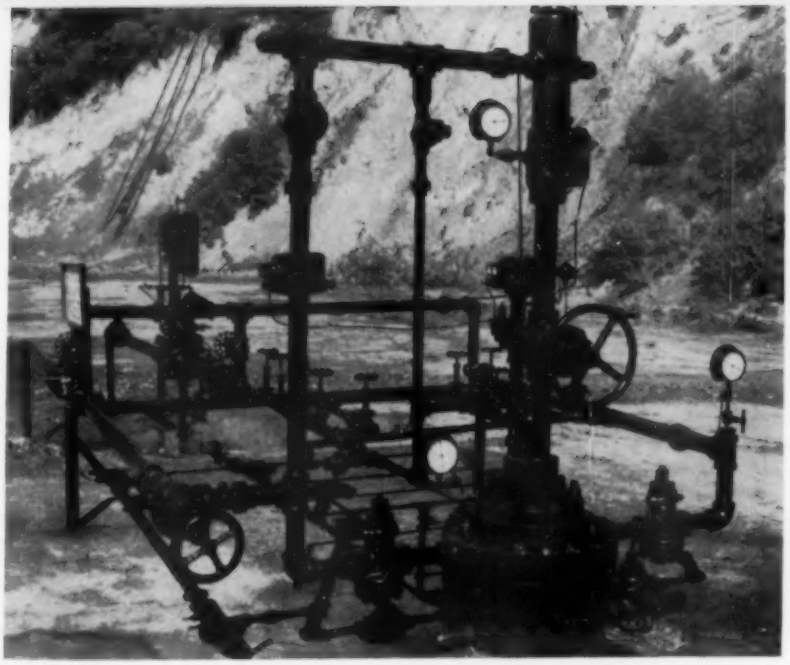
2½-IN. E.U. BY 2-IN. REG. TUBING SWAGE
2-IN. REG. A.P.I. SHOE WITH 2-IN. STANDING VALVE
1¼ BY 1-IN. L.P. SWAGE
2-IN. REG. BY 1½-IN. L.P. SWAGE
USE 1½ BY 1-IN. CLAMPS
5 OR 4½-IN. O.D. LINER
1¼ BY 1-IN. TOMLINSON FOOT PIECE
1½ IN. A.P.I. SHOE WITH 1½ IN. STANDING VALVE



SCHEMATIC DIAGRAM (left, Fig. 1) of dual-string plunger pumping hookup used in high-fluid-level wells. Above, Fig. 2: Surface equipment at a San Miguelito well equipped for dual-string plunger lift.

Dual-String Plunger

Second string provides lift gas,

By L. J. Tomlinson

A PLUNGER-LIFT method which uses parallel tubing strings has been successfully field tested by Continental Oil Co. in San Miguelito and Seal Beach fields. As much as 5 years' experience in low-volume wells indicates the method can be used to produce relatively deep wells to their final economic limit.

Dual-string plunger-lift equipment, developed and patented by the author, is installed in 54 wells in these two California fields. In most cases fluid is being lifted from depths below 6,000 ft. Wells with a net oil output as small as 8 bbl. daily are produced with low injected gas-oil ratios.

Since the first experimental unit was installed at Seal Beach in early 1951, the method has been used to produce more than 2,285,000 bbl. of oil and 500,000 bbl. of water. Total cost for equipment repair and replacement during this period was less than $3,000.

No pulling jobs have been necessary due to failure of the plunger lift. The original installation had been in operation 4 years before tubing was pulled. Then it was only to inspect the condition of the equipment. A leaky macaroni joint was replaced but the original standing valve was found in excellent condition and was rerun.

Author is district superintendent, Continental Oil Co., Ventura, Calif.

Two types used . . . Two basic types are being used. In high-fluid-level wells, 2½ and 1¼-in. tubing are run inside 7-in. or larger casing as diagramed in Fig. 1 (surface hookup shown in Fig. 2). The two strings are connected by a footpiece. Above this in the production string a shoe holds the bumper spring for a National expanding-type plunger.

Below the footpiece the production string is swaged down to 2-in. Below this is placed the standing valve. Two-inch tail pipe then is run to near bottom.

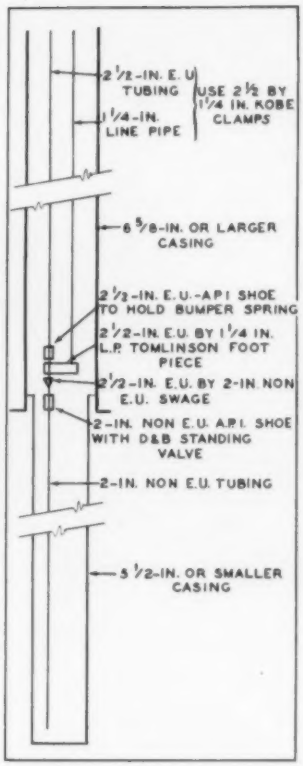
In wells having low fluid levels a two-stage hookup is used (see Fig. 4). In these the 2½-in. production string is first swaged down to 2-in., below which is a 2-in. standing valve. So that both strings can be run inside 5-in. liners, the tubing is further reduced to 1½ in. and the macaroni string swaged down from 1½ in. to 1 in. The footpiece and a 1½-in. A.P.I. shoe with standing valve are run near bottom.

In wells completed in this manner, fluid is intermittently gas lifted from near bottom into the 2½-in. tubing. It is then raised to the surface by plunger lift. Injected gas pressure never is applied to the face of the sand.

Increased oil production . . . Production records of several Seal Beach wells show that the gross output of a parallel-string plunger well often is higher after being changed from conventional pumping, straight gas lifting, or conventional plunger lifting. In most cases at San Miguelito, the wells have been capable of higher production rates than were possible when flowing.

A Seal Beach well not only illustrates these improvements but has the further distinction of having been the first well to be equipped in this manner.

In January 1949, immediately after additional perforations were made in the interval 5,165-5,565 ft., the well was pumped with a rod pump set at 5,067 ft. Several operational changes were made in an attempt to improve the low volumetric efficiency. Maximum production rate netted 76 bbl.


2 1/2-IN. E.U. TUBING
1 1/4-IN. LINE PIPE
USE 2 1/2 BY 1 1/4 IN. KOBE CLAMPS
6 5/8-IN. OR LARGER CASING
2 1/2-IN. E.U.-API SHOE TO HOLD BUMPER SPRING
2 1/2-IN. E.U. BY 1 1/4 IN. L.P. TOMLINSON FOOT PIECE
2 1/2-IN. E.U. BY 2-IN. NON E.U. SWAGE
2-IN. NON E.U. API SHOE WITH D&B STANDING VALVE
2-IN. NON E.U. TUBING
5 1/2-IN. OR SMALLER CASING

SURFACE CONTROLS (Fig. 3, above) for a Seal Beach well which largely uses reservoir gas to plunger-lift well's output. Right, Fig. 4: In wells with low fluid levels the parallel strings are run almost to bottom. Fluid is gas lifted in macaroni string and then raised to surface by plunger lift in the second stage.

Lift Is Paying Off

keeps pressure off producing formation

daily of gross fluid, cut 30 per cent with water.

Despite adequate submergence being maintained, the volumetric efficiency remained low. Thus in April 1949 beam pumping was abandoned in favor of conventional plunger lifting. Just prior to the change a production test showed the well capable of producing 54 bbl. gross daily.

Two methods tried . . . Installation of this equipment, with the plunger operating from a depth of 5,142 ft., improved production by 19 bbl. daily gross. The water cut dropped to 20 per cent. Circulated gas required to lift the 73 bbl. of gross fluid was 2,520 ft. per barrel of fluid.

In March 1951, just prior to being converted to dual-string lift, the well produced 35 bbl. of oil and 9 bbl. of water daily during a 10-day test. The plunger lift was operating at capacity throughout this test period. Input gas required was 2,727 cu. ft. per barrel of fluid produced.

The well then was converted to parallel-string, with the plunger lift tubed to 5,760 ft. and 180 ft. of 2-in. tail pipe extended below. For the next month its output averaged 97 bbl. daily with a 13 per cent cut. During the last 10 days of the test average gross production was 108 bbl. daily. The water cut averaged 13 bbl., or a net of 95 bbl. of oil daily was produced.

Its output has slowly declined during the past 5 years and currently is 32 bbl. of oil and 20 bbl. of water daily. It has been on continuous production the entire period except, as mentioned earlier, when the tubing was pulled last year to check the condition of the equipment. Required plant gas for lifting the 42 bbl. of fluid is in the order of 2,000 cu. ft. per barrel.

Gas economy . . . Another example of the higher oil production, and of the gas economy possible with two-stage lifting, is offered by a shallow Seal Beach producer. Immediately prior to installation of pumping equipment the well produced 128 bbl. of oil and 17 bbl. of water daily on straight gas lift from a tubed depth of 3,999 ft. In March 1952, following the setting of a 1½-in. plunger pump at 5,214 ft., tank tests indicated a production rate of 133 bbl. of oil and 23 bbl. of water daily.

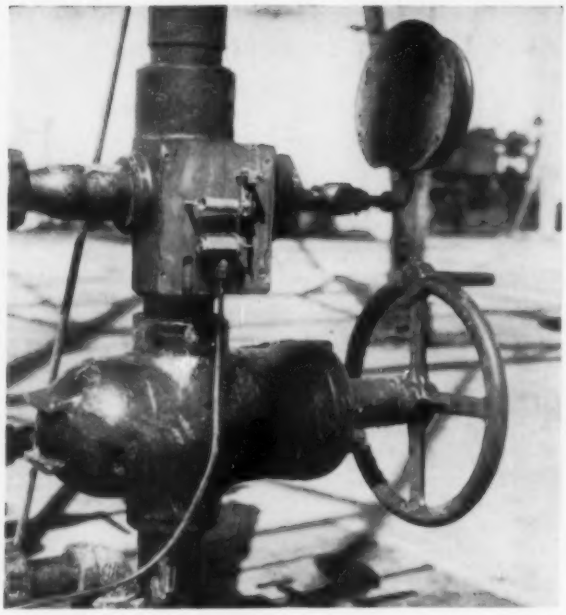
After dual-string pumper lift was installed in July 1952, tank tests run monthly through December placed the well's output at 230 bbl. of oil and 33 bbl. of water daily. With the plunger lifting from 5,240 ft., below which 500 ft. of 2-in. tail pipe extends, current output is 80 bbl. of oil and 55 bbl. of water. Injected gas-fluid raito is about 1,835 cu. ft. per gross barrel.

Gas is injected at 40-minute intervals, with the plunger and its load surfacing in about 15 minutes. After the load is produced, macaroni pressure quickly bleeds off to approximately 220 psi.

Well gas utilized . . . The method is well adapted to using reservoir gas to greatly prolong the flowing life of a well. The method is of a transitory nature but it can greatly conserve reservoir energy and reduce net gas-oil ratios. Five San Miguelito and one Seal Beach well are now being produced in this manner.

The Seal Beach well is of particular interest since it was dual-string gas lifted by its own energy from October 1952 to March 1956. The well has a total depth of 9,008 ft. and is

TIME CYCLE intermitter used to control the intervals and period of time at which gas is injected in dual-string plunger-lifted wells. Fig. 5.



SURFACING of the plunger in the chamber operates a piston to allow tubing pressure to bleed off. The plunger then returns to bottom for another load. Fig. 6.

equipped with 5-in. liner below the casing point of 7,674 ft. In October 1951 it flowed an average of 137 bbl. of oil and 5 bbl. of water daily with the tubing set at 7,733 ft. Decline set in shortly after.

It first was placed on gas lift through ¼-in. holes punched in the 2½-in. tubing at 5,978-80 ft. Equipped in this manner the well during April to December 1952 averaged 271 bbl. of oil and 8 bbl. of water daily. Injected gas averaged 218,000 cu. ft daily, or 787 cu. ft. per barrel of gross fluid. Net oil production at the end of the period was averaging 245 bbl. daily.

Late in September 1952 the well was equipped for dual-string gas lifting. Dual strings of 2½ and 1¼-in. tubing were run to 6,354 ft., below which was placed 1,285 ft. of 2-in. tail pipe. Through lowering the back pressure on the pay, production increased to 355 bbl. of net oil daily. Output during a 5-day test in January 1953 averaged 234 bbl. of oil and 3 bbl. of water daily. No high-pressure field gas was required.

The well continued to produce on this basis until November 1953. At that time the parallel strings were lowered to 7,600 ft. and the plunger put in operation.

Declining reservoir pressure required that a small amount of 550-psi. plant gas be injected, starting in March 1956. Current output, with only a small volume of outside gas being intermitted, is 80 bbl. of oil and 9 bbl. of water daily.

While the well was on dual-string lift with reservoir gas, the 1½-in. macaroni string was hooked up to the casing head. Casing pressures would build up slightly between flows. A time-cycle intermitter regulated the intervals at which gas would be admitted from the annulus into the macaroni string to lift the accumulated fluid to the surface (See Fig. 3 for surface controls).

Two-stage lifting . . . How the parallel-string method can be used to two-stage-lift low-level, low-capacity wells is illustrated by the history of the first well so equipped.

This 8,495-ft. Seal Beach well had been producing about 15 bbl. of oil and 18 bbl. of water daily on straight plunger lift when it was converted to two-stage lift in August 1953. As a two-stage installation—which resulted in pressure being reduced on the face of approximately 1,900 ft. of pay section—output immediately increased to a gross of 66 bbl. Oil output was about 25 bbl. higher. Current production, lifted from 102 ft. off bottom, is 19 bbl. of oil and 5 bbl. of water daily.

The hookup used is that shown in Fig. 4. Seven-inch casing is cemented at 6,688 ft. and a 5½-in. liner extends from 6,639 ft. to total depth. The 2½-in. and 1¼-in. parallel strings are run to 6,601 ft., where they are reduced to 2 and 1 in., respectively. The smaller strings extend to 8,385 ft., 1,784 ft. below the plunger string. A 2 by 1-in. footpiece is set at 8,385 ft. Immediately below this is a 1½-in. A.P.I. shoe and standing valve.

The two-stage injection timing cycle used permits oil to feed into the 2-in. tubing at a minimum bottom-hole pressure. Gas injected through the macaroni string lifts the oil above the 2-in. standing valve at 6,600 ft. The plunger then lifts the oil to the surface. The time cycle can be adjusted to the rate of oil entry into the well bore. A 40-minute cycle is being used.

Time cycle . . . A mechanically reset time clock (Fig. 5) operates the intermitter in the following sequence, for a 40-minute cycle:

1. When the cam follower is displaced from position by a lug, a pilot valve operates to admit gas into the macaroni string. This lifts the plunger and its load to the surface for the primary cycle (about 15 minutes).

2. When the plunger surfaces it depresses a protruding cam in the plunger chamber (see Fig. 6). This releases tension on a spring-loaded piston which moves forward to close a bleed port in the intermitter diaphragm. The plunger remains in the head during the period of tubing bleedoff following the oil flow (about 3 minutes).

3. When the tubing pressure no longer will hold it up, the plunger drops. This action allows the de-

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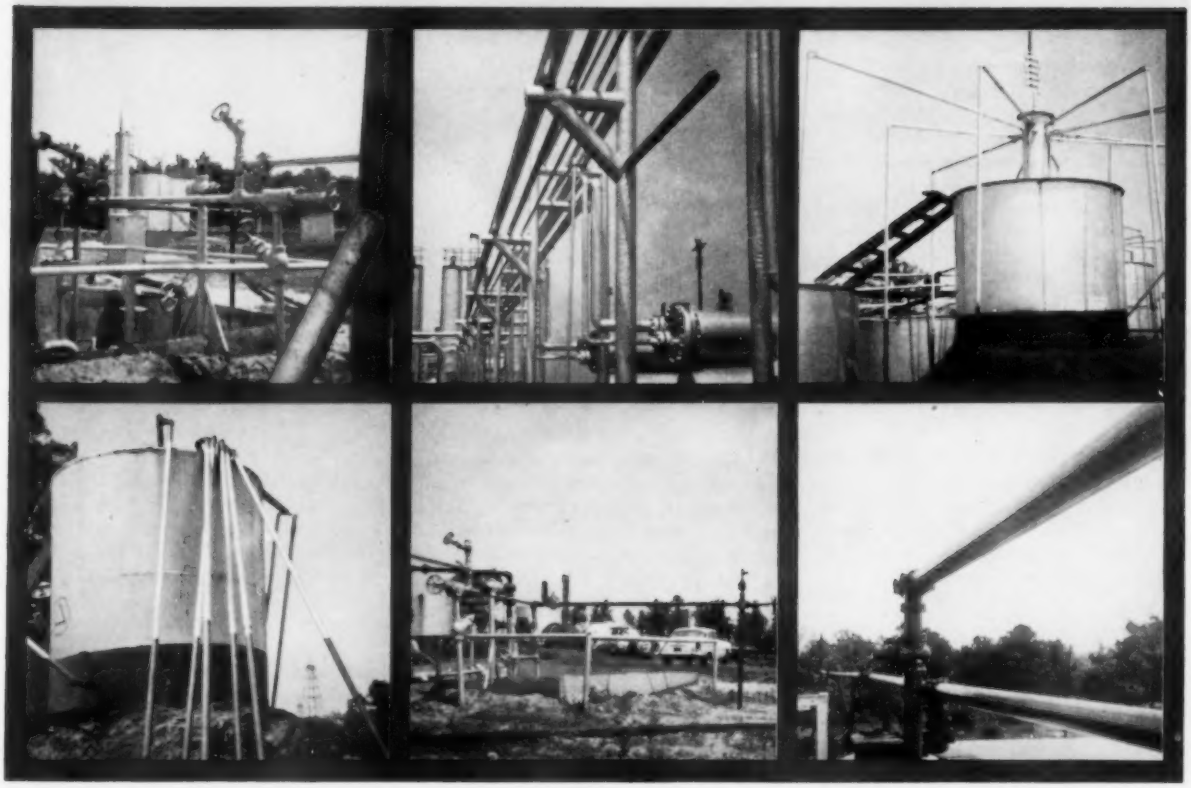

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pressed cam to move forward. This automatically turns on the injection gas for a shorter secondary cycle of about 4 minutes. In this interval the accumulated fluid above the lower (1½-in.) standing valve is lifted above the upper (2-in.) standing valve. The plunger continues its downward trip during this period.

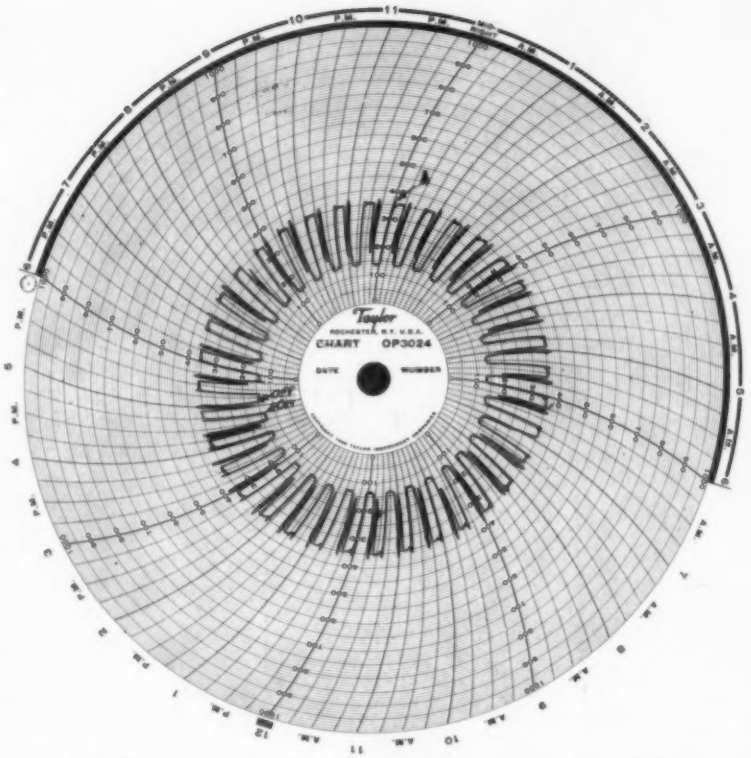
4. Completion of the time period set off on the clock controller results in injection gas being shut off. This allows the plunger to seat on the bumper spring and complete the cycle. Gas remains shut off throughout rest of this period. Thus no pressure is held on the face of the pay while oil is feeding into the well bore (time 20 minutes).

A typical chart recorded during a 24-hour period is shown in Fig. 7. Start of the time cycle discussed above begins at A and is repeated at 40-minute intervals. Injected gas-oil ratio for lifting the current 24 bbl. fluid output is approximately 3,000 cu. ft. per barrel.

Two "pumping" type wells at San Miguelito better illustrate the small volumes which can economically be produced by this method. At one 7,600-ft. well, in which 1,550 ft. of 1½ and 1-in. tubing are run inside 5-in. liner, 9 bbl. of oil daily is being produced.

Injected gas-oil ratio is 4,500 cu. ft. per gross barrel.

Another 7,400-ft. well, equipped with 1,350-ft. of dual string inside 5-in. liner, is producing 10 bbl. of oil and 5 bbl. of water daily.



TYPICAL RECORD of a well produced by two-stage plunger lift. On and off periods of gas injection during the 40-minute cycle are as shown. Fig. 7.

New well completions . . . To convert a well to parallel-string plunger lift requires that a workover rig be brought in, the well killed, tubing pulled, and parallel strings (connected by Kobe clamps) run. To eliminate this expense, wells can be equipped with dual strings upon completions.

After first being permitted to flow naturally, if such is the case, the well can next be gas-lifted. It then can be placed on plunger lift whenever production requires more efficient operation. When fluid levels decline to such a point that it is desirable to go to two-stage lifting, then the parallel strings can be pulled and the depletion-type equipment installed.

. . . An example of this type completion is a 10,281-ft. well completed at Seal Beach in January 1953. A string of 7-in. casing was cemented at 8,133 ft., and a 5-in. liner then landed at 10,278 ft. A parallel string of 2½ and 1¼-in. tubing was run to 8,084 ft., below which 1,997 ft. of 2-in. tail pipe was extended to 10,081 ft. The bumper-spring shoe, footpiece, and standing valve were installed as in a conventional plunger-lift well.

Completion procedure was as follows: The slotted 5-in. liner was hung and parallel tubing strings run without changing the oil-base mud employed drilling into the pay zone. Mud then was displaced with 28°-gravity crude and circulation continued until clean crude was being returned to the surface.

Using 1,500-psi. field gas, pressure was alternately applied to the casing and then bled off. At the conclusion of the "rocking" technique, used to wash all possible mud cake from the face of the sand, full line pressure then was applied down the macaroni tubing. This served to lighten weight of the oil in the tubing. As the well would not flow naturally, it was immediately placed on plunger gas lift. Using a 10-minute injection cycle, its initial output was 169 bbl. of oil and 27 bbl. of water daily.

Operations . . . Of the 54 wells using dual-string plunger lift, 3 are using the two-stage method. In five other low-fluid-level wells, the fluid is lifted from within one joint of the bottom of the hole. Six are using their own gas to intermittently operate the plunger.

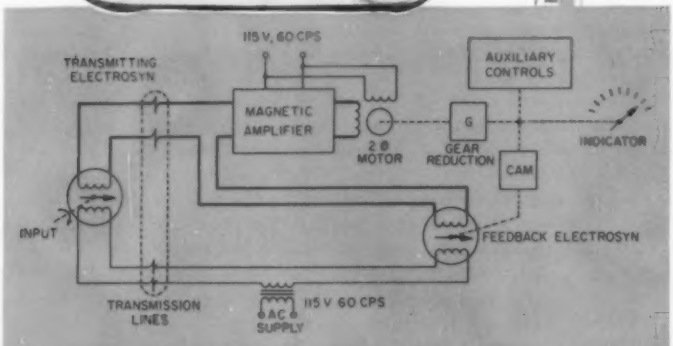
Deepest well equipped for dual-string plunger lift is in San Miguelito field. Parallel strings are hung at 10,240 ft., below which 1,400 ft. of 2-in. tail pipe extends. The well is producing 65 bbl. of gross fluid daily, with a 10 per cent water cut. Injected gas-gross fluid ratio is 3,120 cu. ft. per barrel.

In 20 San Miguelito wells the parallel string extends to about 5,500 ft. Parallel strings, with tail pipe below, are hung at 7,200 to 7,500 ft. in 20 other wells. In one other, parallel strings extend to 8,100 ft. Most Seal Beach installations are equipped with 6,200 to 6,500 ft. of parallel strings.

Several conventional dual-string plunger lift wells are handling large fluid volumes from depths of approximately 10,000 ft. At one 12,123-ft. San Miguelito well, parallel strings are run to 8,006 ft. Below this is 1,520 ft. of tail pipe. With fluid being picked up from 9,526 ft., current output on plunger lift is 190 bbl. of oil and 26 bbl. of water daily.

Most wells are operated on a 40-minute cycle, although some San Miguelito wells are produced at 3-hour intervals. Plunger-lift wells in that field are operated on 475-500-psi. wet field gas; average separator pressure is 70-160 psi. At Seal Beach, dry plant gas is available at well-site pressures of about 550 psi. **End**

ElectroSyn Pressure Transmitter Model 501



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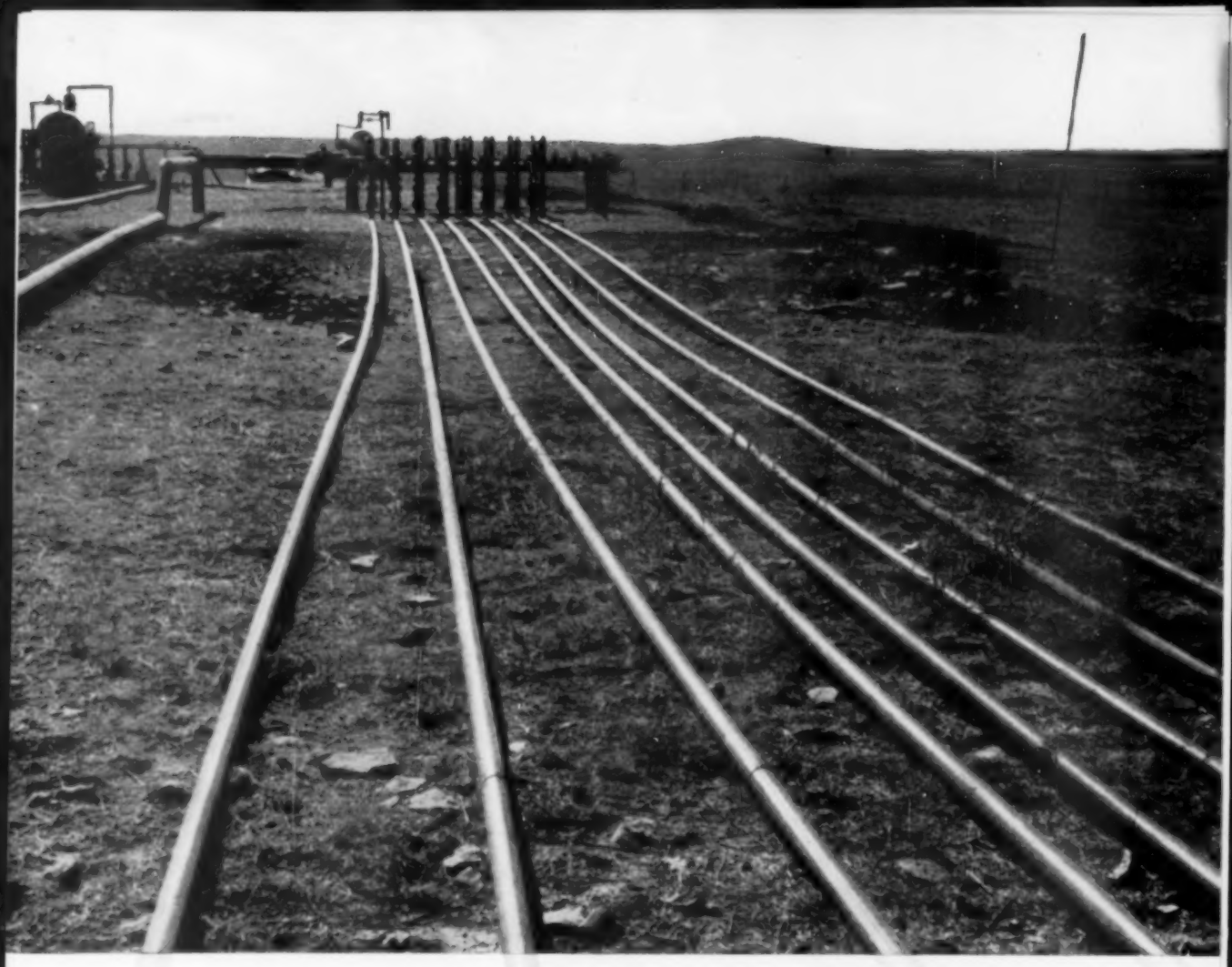

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Here is how a medium-size instrument has been performing in the firm's process engineering division

By Warren Jackson, Jr.

SOHIO'S process engineering division has had a medium-size general-purpose computer in operation for somewhat over a year. It is the kind generally referred to as an electronic analog differential analyzer. We had a small amount of analog-computer experience prior to this installation. While the sum total of this experience is not large, the application of these techniques is so new to the petroleum industry that a discussion of our efforts may be useful to others.

A specific example of analog computer application is given, involving the pH control system on a cooling tower.

Analog computers of this type have been used extensively in the aircraft industry for the past 10 to 15 years, and to a lesser extent in other fields. It seems likely that they will become equally important in the process industries in the next few years.

What Is an Analog Computer?

An analog computer is one which uses physical quantities to represent the numbers in a problem. The distance between points on a slide-rule scale and the air pressure in a pneumatic controller are examples. In the electronic computers to be discussed, the variables in a problem are represented by voltages. Because discreet numbers are not handled by this kind of computer, as they are in an adding machine, the accuracy is limited by the precision of the computing hardware. However, accuracy on the order of good slide-rule accuracy is readily obtained.

What Is Simulation?

The general technique of simulation, which we have used almost exclusively with process problems, consists of setting up a mathematical model of the process system or situation concerned, programing it on the computer, and performing experiments on the computer to determine such things as performance, operating conditions, design parameters, etc. The **setting up of the problem** can be done piecemeal where each segment of the problem can be studied and simulated separately. The **final programing** on the computer then connects these portions together to produce a complete model.

The model should then behave like the system in the problem, within the accuracy of the analysis and the computer. In general the computer's accuracy is far greater than the problem-data accuracy and so represents no problem. This technique of analog simulation permits the man with the problem to work with something which seems fairly familiar to him. The knobs, switches, meters, and recorders on the computer are sufficiently like the controls and instruments in a process that the problem solver feels quite at home.

A pilot model . . . This procedure in effect gives the man a pilot model of his process or system to experiment with without the difficulty of size scaling usually associated with pilot equipment. Some advantages in using this approach to problems are:

1. More thorough and complex calculations can be accomplished than when using desk calculators.
2. This approach is cheaper and safer, when applicable, than performing plant or pilot plant tests.
3. This procedure is more flexible than lab or plant tests especially when new ideas are to be evaluated which would involve the construction of apparatus.
4. The time scale of the model can be speeded up, thus allowing many more experiments in a given amount of working time.
5. Plant production is not upset by this method.
6. The problem solver obtains a better feel for his problem because he can watch or record any of the variables in the problem during the experiments. This frequently produces byproduct information and promotes new ideas.
7. The problem solver is forced by the nature of the computer operation to thorough analysis of the problem This is frequently so difficult that it often appears to be a disadvantage, but in reality can be extremely valuable.

How Much Time?

As with most computer techniques the actual computation time for a problem is relatively small. Usually by far the greatest amount of time is spent in problem analysis, and this requires the greatest ability. Program-

There are many areas it wants to tackle, but here's . . .

Where Sohio has had experience

1. **Prototype for special-purpose computers.**
2. **Evaluation of process-control systems.**
3. **Investigating reaction mechanisms.**
4. **Evaluation of control instruments for general situations.**
5. **Evaluation of hypothetical equipment (or ideas) before construction.**

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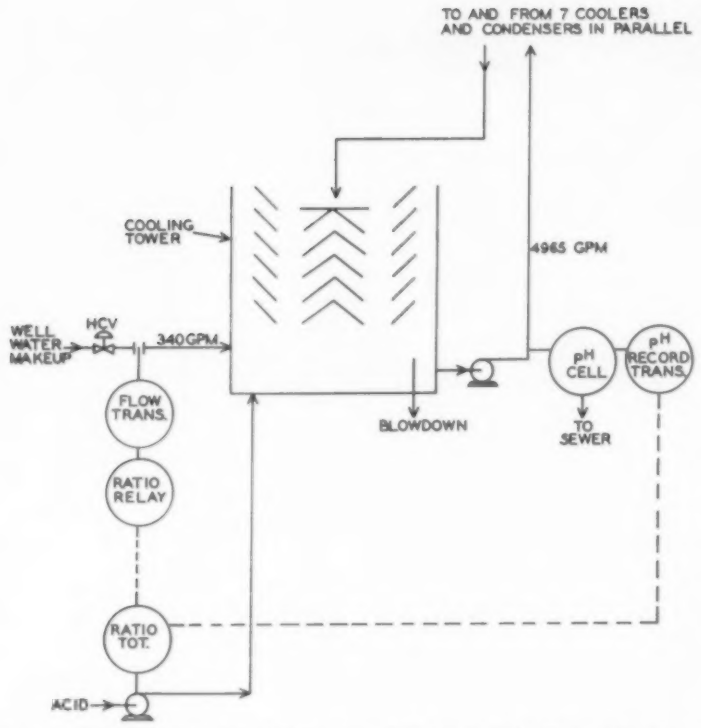


SIMPLIFIED PROCESS DRAWING of cooling circuit and pH control system. The pH of the water and the makeup water flow rate control a variable-stroke acid pump. Fig. 1.

ing for the computer is usually relatively straightforward and can be done by anyone with some previous experience. The wiring of the problem board, i.e., setting up the computer, and the operation of the computer during the experiments is generally done by a technician who is directed by the man with the problem. This phase of the problem solution is not at all difficult.

For example, the problem to be subsequently discussed in detail took something like 1 man-month of analysis time by a number of technical specialists. The programing took about ½ man-day, and the problem board wiring about 1 man-hour. Several days were spent in checking out the simulation on the computer and in performing the experiments.

Library of standard circuits . . . It is probable that the great amount of problem analysis time required will be reduced as we become more experienced in this work. In fact we are looking forward to the time when these problems can be done to a large extent by what is known as **direct simulation.** This is the technique wherein problems are simulated through the use of preestablished computer circuits, thereby eliminating the step of mathematical analysis. Using direct simulation, one would simulate a heat exchanger or process controller by merely consulting the library of standard circuits and programing in the particular properties of the specific device to be simulated.

What Types of Computers?

Analog computers, which are one of the tools used for simulation, fall into two general classes: (1) the special-purpose computer and (2) the general-purpose computer.

Special-purpose computer . . . This is usualy smaller, cheaper, and easier to use than a general-purpose computer. It has gained these advantages, however, by being designed for only one particular problem, or at best a particular class of problems. For example, a gasoline-blending computer, which we call a matrix multiplier, has been described by Karl L. Shull, of Sohio's Lima refinery, in a paper presented at the Regional W.P.R.A. meeting last year at Toledo, Ohio, and printed in The Oil and Gas Journal, August 6, 1956. This computer is really a model of a gasoline batch. The operator sets dials on the computer to indicate the properties of the blending stocks and the proportions of a trial blend, and the computer indicates the properties of the blend. Several of these computers are currently in use in our refineries.

General-purpose analog computers . . . These are usually considerably larger, nonportable, more costly, and more difficult to maintain and operate. However, they are far more flexible in what they do. They are called general purpose primarily because they are built to perform a wide variety of fundamental mathematical operations, such as addition, subtraction, multiplication, division, integration, differentiation, etc. The example problem about to be described required the use of about 30 per cent of this computer's maximum capacity.

Unlike digital computers the size of the problems which can be solved is definitely limited by the size of the computer. It is not possible with these analog computers to do a larger problem merely by allowing the machine to work more slowly. All problems can be solved at the same speed until the maximum capacity of the machine has been reached. Beyond this level problems cannot be solved without expanding the computer.

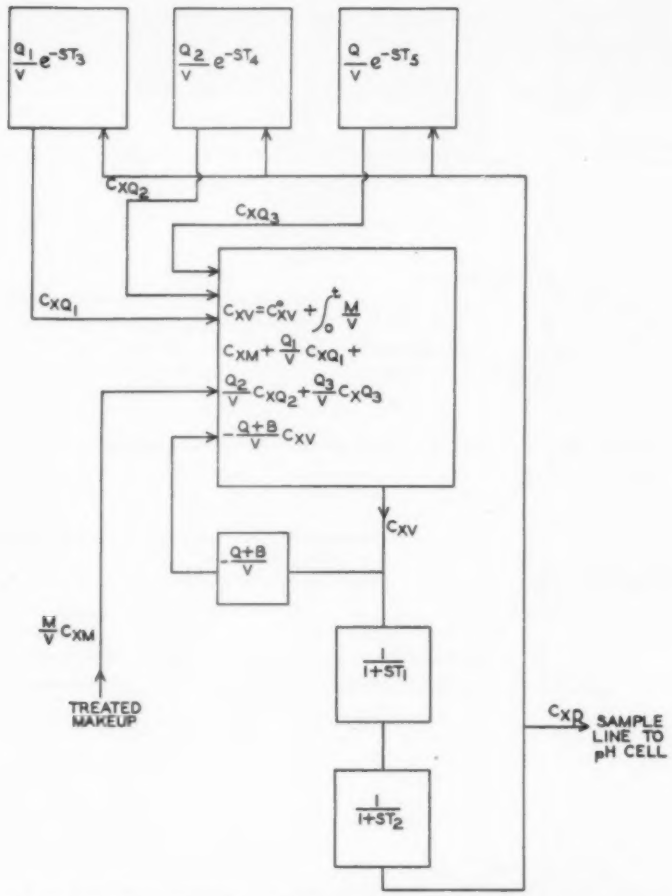
What Are Some Applications?

We have applied our general-purpose computer in a number of areas in the relatively short time it has been in use. There are many more we are eager to tackle as manpower availability permits. Some of the areas in which we have had experience are:

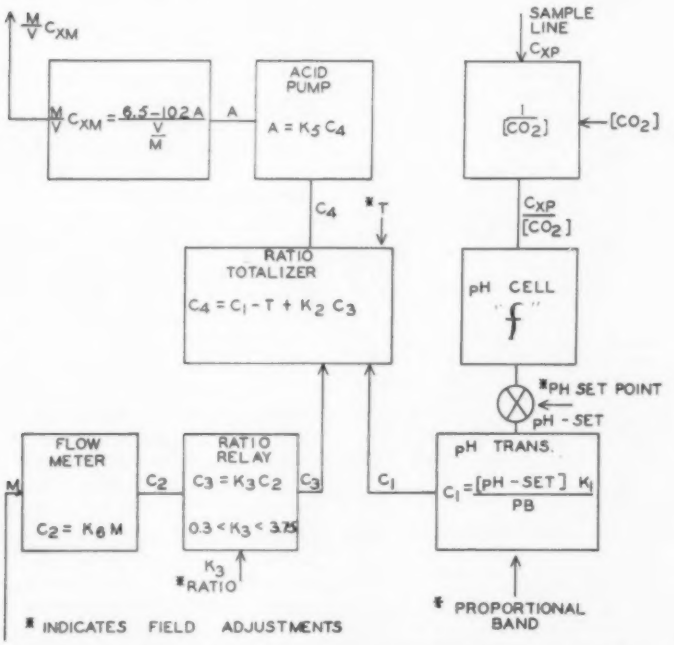
1. Prototype for special-purpose computers.
2. Evaluation of process-control systems
   (a) Unusual process situations
   (b) Unusual control systems
   (c) Trouble shooting existing systems.
3. Investigating reaction mechanisms.
4. Evaluation of control instruments for general situations.
5. Evaluation of hypothetical equipment (ideas) before construction.

As prototype computer . . . We have used the general-purpose computer as a prototype for investigating applications and designs for special-purpose computers. This has allowed us to simulate a special-purpose computer, such as the matrix multiplier, and to try sample problems on it before going through the steps of detailed mechanical design and construction. This gives the special-purpose-computer designer a better idea of the usefulness and design considerations before he goes very deep in a project.

Evaluate process-control systems . . . We have used the general-purpose computer to evaluate process-control systems in a number of different circumstances. Several of these are: (1)



MATHEMATICAL MODEL of the process portion of cooling-tower water-system problem. Each block represents small portion of problem and contains the equations for that portion. Fig. 2.



CONTROL-SYSTEM PORTION of the problem. Instruments are represented only by arithmetic equations describing their behavior as published by manufacturer. Fig. 3.

the problem where conventional control-system design is applied to an unusual process situation; (2) the problem where new or unusual control systems are proposed; and (3) the type of problem involving trouble shooting on existing control systems which do not function properly.

In these situations it has proved helpful to be able to simulate the equipment involved and to run experiments on the computer. Because of the ease with which the computer can be set up or changed, it is a simple matter to investigate process modifications as well as novel or unusual control hardware.

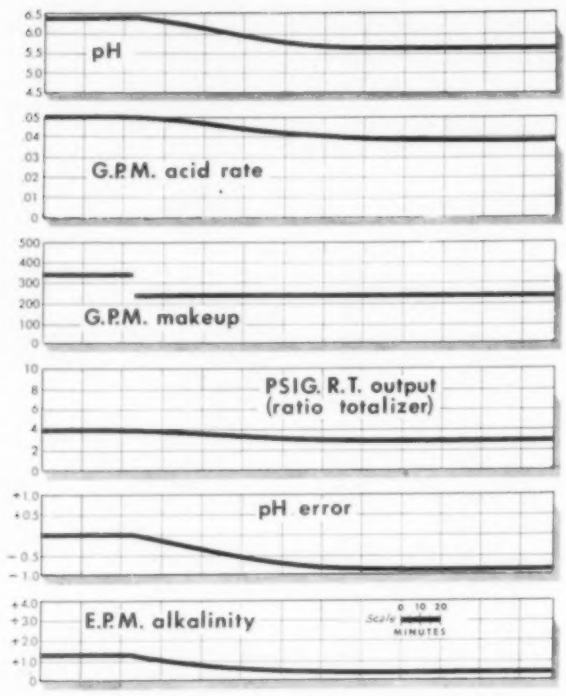
Investigating reaction mechanisms . . . It is possible to study, on the computer, reaction kinetics for various proposed reaction mechanisms. This is a trial-and-error procedure but is fairly rapid and convenient to do on the computer. When a proposed mechanism is found which satisfies experimental data, one has some assurance that it is the proper mechanism. In some cases proper residence time in a reactor can be estimated by this technique.

Evaluating control instruments . . . Some work has been done in the area of evaluating specific control instruments for certain common applications. The effort has been directed mainly toward comparing different makes and types of instruments in a given situation to see whether or not more expensive and complex apparatus can be justified in terms of performance. This includes such things as board-mounted versus field-mounted controllers and the usefulness of boosters.

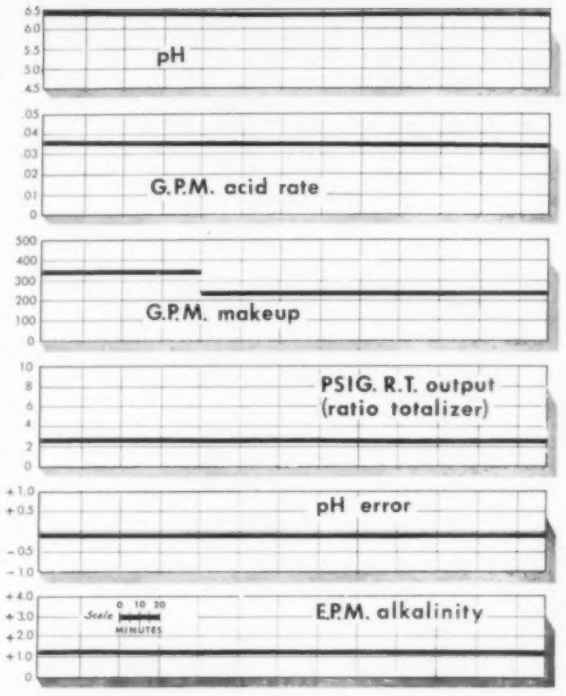
Evaluating equipment ideas . . . Because of the ease and flexibility with which the computer can be set up and changed, it is possible to evaluate hypothetical equipment, that is, ideas or inventions in their earliest stages. It is not necessary for a piece of apparatus to exist in order for it to be simulated on the computer. It is only necessary that a clear mathematical concept of the idea be available. This permits a rapid and inexpensive preliminary evaluation of ideas, thus enabling the better ideas to be more quickly reduced to practice.

Example—Cooling Tower pH Control

A relatively simple example, using the technique of simulation, will be described in some detail with the hope of clarifying some of the general ideas discussed earlier. This particular example is a problem involving the pH control system for a cooling tower.



THESE RECORDS ILLUSTRATE an experiment in which the makeup rate to the tower was suddenly changed with the feed forward control loop not in operation. Fig. 4.



BETTER PERFORMANCE was obtained on sudden change in makeup water rate to tower, when the feed forward loop was operating. Fig. 5.

The particular tower studied services a catalytic reforming unit in Sohio's Lima refinery. The pH control system had not been in operation very long and was performing quite erratically. In addition, one portion of the control system had not been installed.

The questions to be answered were essentially:

1. Has the control system been well designed or can it be improved?
2. What is the effect of the portion of the control system not yet installed?

Concern was expressed not only for this particular cooling tower, but because a number of similar control systems were under construction or had been proposed for future installation.

The system . . . Fig. 1 is a simplified process drawing of the cooling circuit and pH control system in question. The cooling-water circuit consists essentially of seven condensers and coolers in parallel. Their flow rates and piping lengths are all different. The pH in the cooling tower basin is controlled by the addition of acid. The control system operates by having the pH of the water and the makeup water flow control a variable-stroke acid pump.

The control loop from the pH cell through the ratio totalizer to the acid pump will be referred to as the feedback loop. The control from the makeup-water flow meter through the ratio relay and ratio totalizer to the acid pump will be called the feed-forward control. The makeup water-flow meter was not connected into the control system in the plant. A number of adjustments in this system are available to the operator. They are:

1. Proportional band and set-point adjustments on the pH recorder controller.
2. The ratio adjustment of the ratio relay.
3. The tension adjustment on the ratio totalizer.

In addition to answering the original questions posed, we proposed to learn from the computer how to make these adjustments.

DEFINITION OF TERMS

Q_n = flow through exchanger in million pounds per minute
V = volume of basin in million pounds
Q = total flow rate in cooling water circuit in million pounds per minute
M = makeup rate in million pounds per minute
B = blowdown rate in million pounds per minute
A = acid flow rate in g.p.m.
C_1 = pH transmitter output in psi.
C_2 = makeup flow-meter transmitter output in psi.
C_3 = ratio relay output in psi.
C_4 = ratio totalizer output in psi.
K_1 = a constant in pH transmitter
K_2 = ratio (gain) of ratio totalizer
K_3 = ratio (gain) of ratio relay
K_4 = time-scale ratio, 60 seconds (problem) = 1 second (machine)
K_5 = a constant in acid pump in g.p.m./psi.
K_6 = a constant in flow meter in psi./g.p.m.
T = tension spring in ratio totalizer in psi.
"f" = precalculated curve relating alkalinity to pH
e = base of naperian logarithms
s = Laplace operator
C_{xym}, C_{xy}, C_{xm}, etc. = net alkalinity in equivalents/million
T_1, T_2 = screen chamber and pump time constants in minutes
T_3, T_4, T_5 = equivalent exchanger transport delay time in minutes

Simplify the problem . . . The next step in the solution of this problem was that of problem simplification. In our original approach to this problem we made a number of simplifying assumptions. The condenser network was simplified by combining those condensers which had nearly the same dynamic effects on the system. The result was three equivalent condensers whose properties were a weighted average of the original condensers which went into them.

Assumption . . . It was assumed that the continuous blowdown rate included the windage losses. The systems involving the addition of chlorine and other additives were neglected except for the fact that the effects of these

materials were considered in some experiments by using their acid equivalents as an approximation.

The carbon dioxide content in the basin was considered as an arbitrary parameter. Since we did not know how to predict carbon dioxide content mathematically, we provided a means for setting in any arbitrary carbon dioxide content. We then repeated a number of our experiments at various carbon dioxide levels to observe the effects of this parameter. We further assumed that all of the control instruments operated so rapidly that their dynamic effects could be neglected when compared to the process dynamics which had time constants of ½ to 6 minutes. The effects of temperature changes in the tower and changing heat loads were also neglected. This may seem like a large number of assumptions, and actually there may have been a few more, but our results indicated that they were justified in view of the particular answers we were seeking.

Derive equations . . . The next phase of the problem, which was by far the most difficult, consisted of deriving equations for all parts of the system under study. The results of this analysis are shown in Figs. 2 and 3. Fig. 2 is a block diagram of the mathematical model of the process portion of the problem. Each block represents a small portion of the problem and contains within it the equations for that portion. The condensers are represented mathematically as pure transport delays. We merely calculated the time it would take a droplet of water to flow from the pumps, around the circuit, and back to the basin for each condenser. The basin and pits were represented as simple exponential mixing lags wherein perfect mixing is assumed.

Calculating pH . . . The real difficulty in the analysis of this problem was deriving the equations which would predict pH in the tower basin as a function of the known operating conditions. This was done by calculating ion concentrations obtained through material balance calculations around the basin. The pH was then calculated from the ion concentrations by the simultaneous solution of two equations involving the hydrogen ion concentration as an implicit variable. Actually these equations were presolved by hand calculation and a curve obtained which related the ion concentration divided by the carbon dioxide content to pH.

This curve was then programed on the computer through the use of a diode function generator, indicated by "f" on the diagram. These equations were checked by using them to predict the titration curve for a sample of plant well water and comparing with a laboratory titration. The model of the control circuits is shown in Fig. 3. The instruments are represented only by arithmetic equations describing their behavior as published by the manufacturer.

Results . . . This model was wired up on the computer and checked out mathematically. The model was then operated under a variety of operating conditions, and the resulting performance observed by recording pH, acid flow rate, makeup water rate, ion concentration, and instrument air pressure versus time on a strip chart recorder. A typical recorder chart is shown in Fig. 4.

This particular recording illustrates an experiment wherein the makeup rate to the tower was suddenly changed with the feedforward control loop not in operation. The resulting changes in the variables can be seen. Better performance was obtained under these conditions with the feedforward loop operating, as shown in Fig. 5. The principal improvement was in the reduction in pH offset.

Some of the conditions under which this model was operated are:

1. Makeup flow-rate changes
   (a) 340→240 g.p.m.
   (b) 340→440 g.p.m.
2. Makeup-water alkalinity changes.
3. Different proportional band settings: (a) 10 per cent; (b) 100 per cent.
4. Acid strength variations.
5. With and without feed forward and/or feedback control loops operating.

Similar experiments were carried out under the conditions of makeup-flow-rate changes, makeup-water-alkalinity changes, acid-strength variations, different proportional band settings, and with and without the feedforward and feedback control loops operating.

Conclusions

From this experimental work we were able to draw a number of conclusions. They are as follows:

1. The control-system design is very good, being capable of excellent control with a high degree of stability. Any difficulties found in the field are likely to be due to equipment malfunctioning or maladjustment rather than to control-system design. This also implies there is no question as to the controllability of the process also.

2. The feedforward control loop from the makeup-flow-rate transmitter is very effective in reducing pH variations in the face of makeup-water flow-rate changes, but serves no useful purpose other than that. This is the portion of the control system which had not been installed in the plant. With sizable makeup-flow-rate changes, this portion of the system accounted for a pH offset reduction of from 10 to 20 times. If the makeup rate is constant, this control loop is not necessary.

3. The system is inherently stable even at the lowest proportional band adjustament attainable. With this particular equipment the adjust was 10 per cent proportional band.

The conclusions thus far stated have been confirmed by operation in the refinery. The following additional conclusions were also obtained:

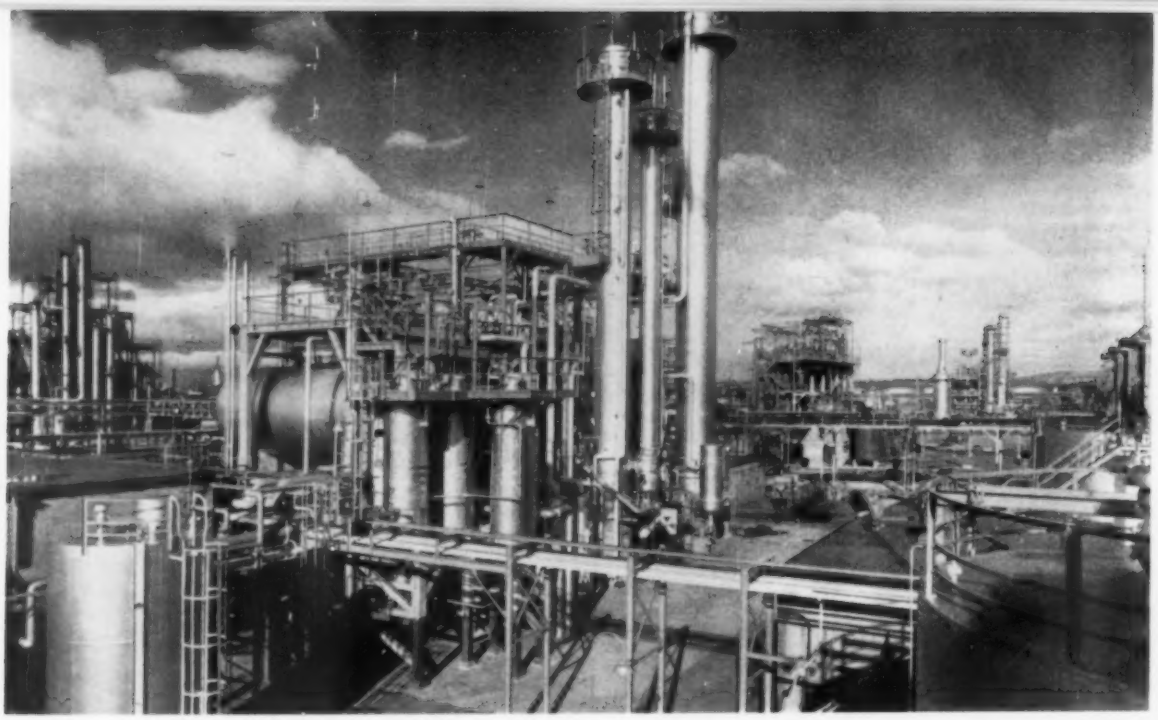
4. The feedback loop from the pH transmitter reduces the system response time from 2½ to 15 times, and the pH offset from 5 to 25 times for proportional-band settings of 100 and 10 per cent as compared to no control.

5. Small changes in raw water pH in the direction of a higher pH causes much less trouble than small changes in the direction of a lower pH. The same effect was observed for makeup flow-rate changes without the feedforward control loop in operation.

6. If no automatic-control equipment is available to take care of additive additions, much closer control could be expected if the acid addition rate were reduced or stopped altogether during these additive additions. In other words, better performance is achieved through controlling in the direction of too high a pH rather than too low a pH.

7. A method was found for quickly and accurately establishing the proper control instrument settings for a given set of operating conditions.

In this instance satisfactory operation of the pH control system was obtained by mechanical maintenance and improvements in the pH cell-sample system, acid pump, acid lines, and others. This would have occurred whether or not the computer had been used. On the other hand the application of the computer to the problem has saved and will save concern regarding the proper design of the system and has led to a much better understanding of the equipment. If further problems of this sort should arise, we will be better equipped to get them on the computer promptly and easily. If the control-system design had been faulty, the computer would have told us and would have allowed us to quickly improve the situation. **End.**



BRITISH HYDROCARBON CHEMICALS, LTD.—Plant at Grangemouth, Scotland. No. 1 ethanol plant at left and center and isopropanol and detergent alkylate plants in right foreground.

A PROGRESS REPORT

Nine Producers Lead in Britain's 400,000-Ton Petrochemical Parade

Suez crisis had little effect on growth of this burgeoning industry

IT was not until 1942 that the first petroleum chemicals were manufactured outside the United States. In that year production was begun in Britain of synthetic detergents and certain intermediate chemicals. Soon after World War II several large installations were erected to account for an extensive range of petroleum chemicals, including solvents, resins, plastics, fibers, detergents, antifreeze compounds, sulfur, and carbon black.

Oil and chemical . . . In 1956 the United Kingdom output of petroleum chemicals was running at an annual rate of 400,000 long tons. The units of which it is composed include plants operated both by chemical companies and oil companies; but, recently, there has been a pronounced tendency for oil and chemical concerns to form joint companies to promote new petroleum-chemical ventures. And the Suez crisis has had little effect on the growth of this fast-growing industry, since its consumption of oil feed stocks, in relation to the country's total intake of petroleum products, is insignificant.

In the United Kingdom there are nine leading producers of organic chemicals from petroleum: Shell Chemicals and its subsidiary Petrochemicals, Ltd.; British Celanese; Imperial Chemical Industries; British Hydrocarbon Chemicals; Monsanto Chemicals; Forth Chemicals; Grange Chemicals, Associated Ethyl Chemicals, and Esso.

The main production centers are given below:

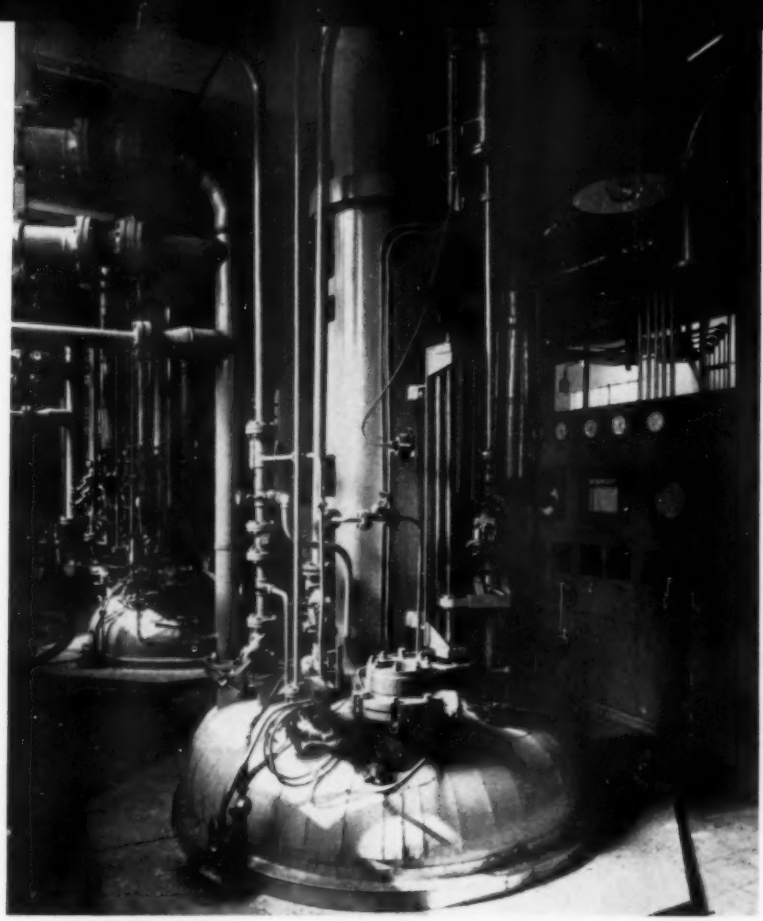
Shell Chemicals	Shellhaven and Stanlow
Petrochemicals, Ltd.	Partington
Forth Chemicals	Grangemouth
British Hydrocarbon Chemicals	Grangemouth
Imperial Chemical Industries	Billingham and Wilton
Monsanto	Newport and Fawley
Esso	Fawley

Products . . . The major products produced by the industry include styrene, ethyl alcohol, polythene, polyvinyl chloride, propylene, butylene, ammonia, detergent alkylates, epikote resins, nitrogen fertilizers, sulfur, and carbon black.

British Hydrocarbon Chemicals

B.H.C., Ltd., is a joint enterprise of British Petroleum Co., Ltd., and Distillers Co., Ltd. It was formed in 1947, under the name of British Petroleum Chemicals, (B.P.C.) Ltd., with a capital of $14,000,000 to produce chemicals from petroleum with a works at Grangemouth in Stirlingshire in Scotland. Its present name was adopted in 1956. The entire remodeling and extension of B.P.C.'s long-established Grangemouth refinery, undertaken in the years immediately after the second world war, afforded the much needed opportunity for the de-

PETROCHEMICALS



EPOXY RESINS—Reactor kettle at Shell's Stanlow refinery, Cheshire.

velopment of the Scottish petroleum chemicals industry.

B.H.C. processing . . . Construction of the plant commenced on a site adjoining the refinery, and in 1951 the first units came into operation. Here seven main processes are carried out: (1) the cracking of petroleum distillate, mainly paraffins, to produce a mixture of gaseous and liquid hydrocarbons; (2) the separation of ethylene and of propylene from the other products of stage (1); (3) the conversion of ethylene into ethyl alcohol; (4) the conversion of propylene into isopropyl alcohol; (5) the conversion of propylene into tetrapropylene; (6) the separation of butadiene from the residual light hydrocarbons from stage (2); and (7) the separation of cyclopentadiene from the residual heavier hydrocarbons from stage (2).

Pyrolysis . . . In each of the two cracking units the petroleum distillate with steam is initially heated to 1,350° F., in a set of four furnaces working in parallel, to form a gaseous mixture of ethylene, propylene, and other compounds. This mixture is quickly cooled, first by passing it through the heat exchangers which reduces its temperature to 650° F. (at the same time producing steam for use in the plant) and then by injecting cold "quench oil," which further reduces the temperature to 275° F.

Low-temperature recovery . . . Following the extraction of distillate and fuel oil, which are passed to the refinery for conversion with normal petroleum products, the gases produced are separated and purified. This is brought about by compressing and refrigerating the mixture until it liquefies, reducing the temperature in steps by cooling with liquid propylene and liquid ethylene, and then fractionally distilling in highly efficient fractionating columns, operating at temperatures down to —150° F., and pressures of about 500 psi. The final products from the gas separation units are ethylene and propylene of high purity, following the removal of H_2S, and a residual mixture which is treated at a later stage.

Making ethanol . . . In each of the two ethanol units, ethanol is made to combine directly with water, under pressure, at an elevated temperature. The reactants are passed over a catalyst and then quickly cooled, the resulting product being a weak aqueous solution of ethyl alcohol. Purification is effected in a series of scrubbers and distillation columns, yielding a very pure final product containing 92.4 per cent by weight of pure alcohol, the remainder being water.

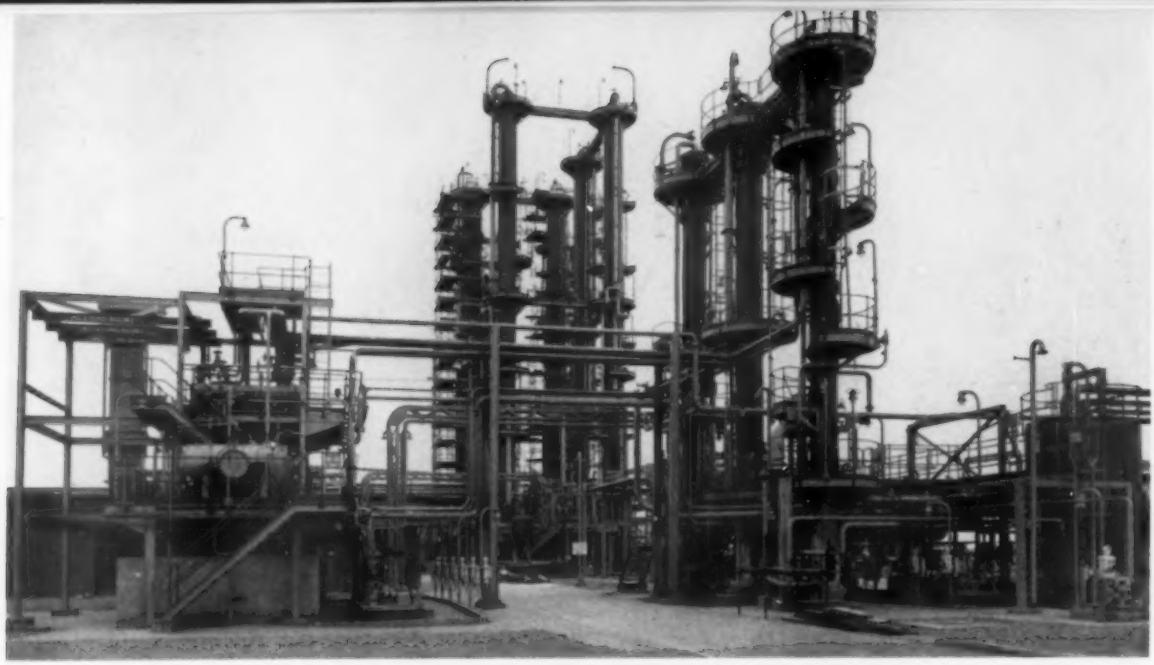
In the conversion of ethylene to ethanol a small amount of diethyl ether is simultaneously produced. Plant has been installed to recover this useful byproduct, which is marketed as a technical-grade material.

Isopropanol . . . The conversion of propylene into isopropyl alcohol is effected in two stages. In the first, the propylene is mixed with sulfuric acid in a series of contacting vessels in which the acid flows through from one end and the propylene from the other. The propyl hydrogen sulfate thus formed is diluted with water, and in this second hydrolysis stage the acid is regenerated as a dilute solution and isopropyl alcohol is formed. It is then purified and concentrated by fractional distillation and produced for sale as a constant-boiling mixture containing 87 per cent of isopropanol and 13 per cent of water. The acid, regenerated as a weak solution in the hydrolyzer, is reconcentrated and used again in the process.

Propylene polymer-dodecene . . . In the tetrapropylene plant, propylene after suitable purification, is heated and passed at elevated temperature and pressure through reactors where it is selectively polymerized in the presence of a catalyst. The effluent, consisting mainly of a mixture of tripropylene, tetrapropylene, higher polymers, and unreacted propylene, is cooled and separated by fractional distillation. The tetrapropylene ("tetramer") produced is manufactured to stringent specifications to insure high quality.

Butadiene-cyclopentadiene . . . Following the extraction of ethylene and propylene in the gas-separation units, a butene-butane fraction of the gases is passed to the butadiene plant where it is treated with a selective solvent. The butadiene is preferentially absorbed by the solvent from which it is recovered by distillation. The resulting product is redistilled to give high-purity butadiene, which is condensed and passed to storage under moderate pressures in spherical Hortonsphere tanks. Finally, cyclopentadiene is isolated from the pentene-pentane fraction of the cracked products as dicyclopentadiene by the employment of a mild polymerization process.

Much of the B.H.C. production is used in the adjoining plants of its associates, and transfer of the various gases and liquids is hence easily carried out by pumping through pipe-



BUTADIENE PLANT—This is the Imperial Chemical Industries Wilton works.

lines. Automatic and electronic control of the production units is a feature of the plant. In addition, routine control of the B.H.C. production processes and the quality of its products entailed the provision of well-equipped laboratories, in which the most modern techniques of analysis and inspection are used. Moreover, the B.H.C. installation has been designed to minimize the risks of fire and other dangers, and a safety department advises the production and maintenance sections on the appropriate measures to be adopted to avoid hazards.

A power station was commissioned in 1951 by Scottish Oils, Ltd., to provide the steam and electric power to the Grangemouth refinery and the B.H.C. plant. The group of chemical factories also uses very large quantities of cooling water. To meet this demand there are seven induced-draft cooling-tower cells and a natural-draft tower with a combined capacity of 2.5 million gallons per hour.

Plastics—Forth Chemicals, Ltd.

In April 1950, British Petroleum Chemicals, Ltd., and Monsanto Chemicals, Ltd., jointly formed Forth Chemicals, Ltd., to produce monomeric styrene, a chemical intermediate for the manufacture of polystyrene plastic, and for a number of other industrial uses. British Hydrocarbons, Ltd., provided a site next to its own works, and a plant was erected and commissioned in early 1953. Late last year, its capacity was expanded to three times its initial designed capacity. Its current production is running at an annual rate of 30,000 long tons.

In January 1955 a third company was added to the group, with the formation of Grange Chemicals, Ltd., jointly owned by British Hydrocarbons, Ltd., and Oronite Chemical Co. of California (a subsidiary of Standard Oil Co. of California). The Grange Chemicals plant, sited within the British Hydrocarbon Chemicals area, was completed at the end of 1955, and produces dodecyl benzene, an intermediate for the manufacture of high-grade synthetic detergents.

To meet the needs of these associates and to satisfy other demands, expansion of British Hydrocarbon Chemicals' plant became necessary, and in June 1955 a program was announced to increase both the quantity and range of its products. Between the final quarter of 1955 and the early part of this year, new construction is calculated to duplicate the existing facilities of cracking and gas-separation plant and the ethyl alcohol unit, and will provide installations to extract butadiene used in the manufacture of synthetic rubbers and to make tetrapropylene, a raw material for Grange Chemicals operations.

Additional ethylene . . . This is needed to meet the expansion of Forth Chemicals' plant, and also part of the ethylene output is to be sold to Union Carbide, Ltd., for the production of polyethylene in a new plant now under way at Grangemouth. Among other products marketed is dicyclopentadiene, a reactive material used particularly in the preparation of insecticides and of drying oils for paints. The new investment by British Hydrocarbon Chemicals, Ltd., amounts to around $22,400,000, and when expansions are completed the works will occupy an area of 118 acres and provide employment for 900 persons.

Carbide

Union Carbide is building a polythene plant at Grangemouth, and will obtain its ethylene supplies under long-term contract from the adjacent British Petroleum Co. refinery. Its initial annual capacity is 11,500 tons and capital outlay around $12,000,000. This unit is scheduled for completion before the end of next year.

Shell

The pioneer petroleum chemicals plant to be built outside the United States was the Shell "Teepol" (synthetic detergent) unit at Stanlow, in England, during the second world war. Now, both the reforming and catalytic cracking processes at the Stanlow refinery yield light hydrocarbons, normally as gases. At this stage oil refining merges into the manufacture of petroleum chemicals.

Stanlow solvents . . . The leading chapter in this development in Britain was opened in 1949, when the Stanlow chemical solvents plant went on stream. This group of integrated installations brought an entirely new enterprise to Britain, and eased the nation's postwar economic problems.

This installation uses gas oil as feed stocks. It is fed into the thermal cracking unit, where it is cracked at elevated temperatures and low pressures, to obtain the maximum formation of gaseous products. The cracked items are roughly separated into heavy fuel oil, which is burned, and a mixture of light components. The latter mixture is fed into a gas-separation unit, and split into five fractions: a

mixture of light gases containing hydrogen, methane, ethane, and ethylene which is burned; three others containing hydrocarbons with 3, 4, and 5 carbon atoms respectively; and a volatile liquid which is blended into motor gasoline.

C_3-C_4 olefins . . . The fraction containing five carbon atoms is returned to the cracking furnace and is further pyrolized. The two fractions with three and four carbon atoms contain a high proportion of reactive olefins, and it is these C_3 and C_4 fractions which form the feed stocks for the manufacture of chemical solvents. Under suitable conditions acetone, derived from isopropyl alcohol, is converted to diacetone alcohol, which, in turn, is transformed to methyl isobutyl ketone via mesityl oxide.

Epoxies . . . Epikote resins are also produced at Stanlow. A new type of condenser polymer developed by Shell, they are clear, amber-colored liquids, or solids, made by reacting diphenylol propane (D.P.P.) with epichlorohydrin (E.C.H.) in the presence of caustic soda solution. D.P.P. is prepared locally in an associated plant for acetone and phenol. E.C.H. is at present imported from the United States. The Stanlow plant is designed to produce seven grades of resins, which differ in the number of D.P.P. and E.C.H. linked together to form the molecule.

The Stanlow epikote and D.P.P. units were designed by Shell associates in Holland, and erected by a British engineering - contracting firm. The combined plants entailed a capital expenditure of $1,960,000 and have a design capacity of 2,000 tons of resins a year.

Epoxy manufacture . . . The heart of the installation is two large reactors, each of which is of all-welded stainless-steel construction. Each of the reactors is equipped with a massive anchor-type stirrer, the blades of which were cast from stainless steel, while the shafts are of mild steel clad with stainless steel. Each stirrer is driven by an 83-hp. motor coupled to the shaft by a variable-speed hydraulic drive. The plant was so designed that two similar reactors can be installed for meeting increased future demands for these resins. The wash water is introduced below the "taffy" level and is drawn off up a pipe which is controlled so that it is just below the surface of the liquid. A slight pressure applied to the vessel causes the wash water to rise through the "dip" pipe.

One of the reactors is normally used for the production of liquid grades and is equipped with a reflux head arranged to remove water from the system and return to the reactor the excess E.C.H. which is used for these grades. Solvent recovery is effected by reducing the pressure of the system by a vacuum set. Either reactor can be used for the preparation of solid grades.

Sulfur recovery . . . Like several other oil processors, Shell at Stanlow has landed in the sulfur production as an adjunct to its routine operations for several reasons: the high sulfur content of the Middle East crudes it normally employs, acute supply shortages of this strategic commodity after the second world war, and the effluent disposal problems closely linked with sulfur removal and sulfuric acid treatment of oil and petroleum chemical products. Moreover, H_2S, one of the products of the cat cracker, is an impurity, and calls for elimination from the fractions of the gas-separation unit before they can be used in the chemical plant.

The Girbotol process is in use at Stanlow for the removal of H_2S from refinery gases employing diethanolamine as reagent. An H_2S gas holder has been installed, since it confers a large measure of operational flexibility by dampening out variations in feed rate and composition, and permits more time for emergency action than is feasible with a direct feed line between the Girbotol plant and the Claus unit.

This installation accounts for 45 long tons a day of sulfur at higher than 99.9 per cent purity. Mild-steel equipment has proved satisfactory, and little danger of corrosion exists provided temperatures are controlled within specified limits—high enough to avoid water-vapor condensation and low enough to circumvent sulfide formation and SO_2 production which can occur in the presence of excess air. Explosion disks are provided to safeguard equipment, and because of the toxic nature of the gas provision has been made to enable the unit to be shut down by remote control from a safe location.

Acid sludge . . . The oil refining as well as the chemical operations at Stanlow use large quantities of sulfuric acid, resulting in the production of spent acid, acid sludge, or acid tar. The disposal of such sludges poses a problem particularly in areas where regulations preclude the discharge of acid to sewers and of acid fumes to the atmosphere. To cope with it a low-temperature sludge decomposer

BRITAIN'S NEWER PLASTICS

Chemical classification—	U. K. manufacture	U. K. trade name	Major applications
Polyethylene:			
(High density)	I.C.I. Ltd.	Alkathene HD	Outlets where high-temperature resistance and greater rigidity are desirable, for e.g. kitchen utensils and sterilizable goods.
(Ziegler)	Petrochemicals	.....	
(Phillips)	Distillers	Marlex	
Polytetrafluoroethylene (p.t.f.e.)	I.C.I. Ltd.	Fluon	Chemical and heat-resistant frictionless surface coatings, high-temperature-resistant gaskets, etc.
Epoxides	Aero Research	Analdite	Protective coatings. Sealings and encapsulating of electrical components. Adhesives notably for metals. Cast press tools and kindred equipment.
	Bakelite	.....	
	Leicester Lovell	.....	
	Shell Chemicals	Epikote	
Polystyrene (lightweight beads)	Styrene products	.....	Low-density insulating medium.
Styrene-butadiene copolymers	I.C.I. Ltd.	Butakon S.	Reinforcement for rubber in manufacture of synthetic shoe-soling materials; also for similar use in floor tiles, etc.
	Monsanto	Tred	
Bakelite (phenol formaldehyde)	Bakelite	Microballoons	Mixed with casting resins for trowelable low-density compositions. As floating top-layer to prevent evaporation in fuel-storage tanks.

plant has been operating at Stanlow since early 1955.

Petrochemicals, Ltd.

The Royal Dutch-Shell group now owns Petrochemicals, Ltd., with production facilities adjoining Manchester, England. This concern accounts for a wide range of petrochemicals including ethylene oxide and ethylene glycol, the raw material being obtained from naphtha cracking. The group has a major interest in Styrene Products, Ltd., and a stake in Styrene Co-polymers, Ltd. — two important English concerns in the plastics field. It also acquired through the purchase of Petrochemicals, Ltd., the exclusive license in the United Kingdom under the patents of Professor Ziegler to a new process which, among other things, includes the manufacture of polyethylene. Mention must also be made of Shell's participation deal with Imperial Chemical Industries, Ltd., by virtue of which it obtains for sale certain alcohols (Oxo alcohols) of great value to the plastics industry.

Dodecylbenzene . . . A new alkylate unit with an annual throughput capacity of 30,000 tons was completed by Shell Chemical Co. as a development to its Shell Haven refinery. The alkylate (dodecylbenzene) is the raw material from which powdered synthetic detergents for domestic purposes are made. Late in 1956, Shell accounted for 24,000 tons of high-grade alkylate a year, which represented over half the total U. K. production. The other British plants are owned by Monsanto and Grange Chemicals. This year the throughput of the Shell unit is being stepped up. With the acquisition in 1955 of Petrochemicals, Ltd., by Shell, an additional range of nonionic detergent materials have become available and all the raw materials for alkylate production emanate from Shell sources. The design of the Shell Haven alkylate installation was prepared by the Royal Dutch-Shell Group, and was based on the experience gained in Holland. Construction work was carried out by Foster Wheeler of London.

Ammonia . . . Shell Chemical's ammonia plant at Shell Haven is planned to begin operations in 1958. Fisons Fertilizers, Ltd., recently entered into a long-term contract with Shell Chemical Co., Ltd., to purchase from it substantial tonnages of ammonia from the Shell Haven plant. It is to be processed in an adjacent installation and thence distributed to various Fisons works for incorporation in fertilizers.

Imperial Chemical Industries

The second olefin (oil-cracking) plant erected on the Wilton site by the Imperial Chemical Industries, Ltd., (I.C.I.) was commissioned in November. Plans for its construction were announced in March 1954, 3 years following the successful startup of the pioneer olefin plant.

Like its predecessor this second installation is divided into three sections: the cracking section converting light-hydrocarbon oils into a mixture of gases and crude gasoline; the gas-separation section, and another section refining the crude gasoline which is piped to the Billingham factory for blending.

The separated gases form the raw materials for other chemical plants, which in turn provide the basic materials for the manufacture of polythene, Terylene polyester fiber, methyl methacrylate plastic, glycol antifreeze, and a variety of new organic chemicals.

The operation of the second olefin plant provides permanent employment for 180 persons. When the third olefin plant is commissioned in 1959 the personnel employed will exceed 700. With the start of the second unit the output of olefins has been doubled and when all the three olefin plants are in production the total ethylene output will be well over 100,000 tons a year, together with an approximately equal amount of propylene, butylenes, and butadiene.

Ethylene glycol . . . Late in 1956 the construction of a second ethylene glycol plant was announced by the company. It will be commissioned early in 1959, about the same time as the third oil cracker, from which it will draw its ethylene. The combined capacity of the two ethylene plants will be 16,000 tons a year. The major outlets of this commodity are for Terylene fiber, automobile antifreeze, and explosives.

Butadiene copolymers . . . The I.C.I. commissioned late last year the plant at Wilton to produce 10,000 tons per annum of butadiene-based materials. It is accounting for a range of copolymers of butadiene with a variety of other monomers such as styrene, acrylonitrile, and methyl methacrylate. These materials are sold under the general trade name of "Butakron," and range in character from rubber-like to rigid resins, and with properties so diverse that they can be employed in the manufacture of rubber, plastics, paints, and paper.

Also, the capacity of this company's Billingham's carbonylation place producing alcohols for the plasticizers used in the polyvinyl chloride industry is being doubled.

Esso

The Esso Fawley refinery will soon provide chemical intermediates to other concerns with the completion of its $25,200,000 plant to produce mainly butadiene and ethylene. The former is to be fed to the installation under way locally sponsored by International Synthetic Rubber Co., while the latter is to be made available to Monsanto's adjacent polythene plant.

Synthetic rubber . . . The International Synthetic Rubber Consortium, a group formed by Dunlop and other major rubber-processing companies in the U. K., will use substantial quantities of Petrochemicals' styrene for making synthetic rubber. Plans for building this $14,000,000 major synthetic-rubber plant were approved in mid-1956. The installation was designed and planned by Blaw-Knox, Pittsburgh. Construction is being carried out by British contractors and the bulk of the machinery and equipment will be purchased locally. This plant is to be commissioned in 1958 with an annual output capacity of 52,000 long tons. Including other synthetic rubber units already in operation—I.C.I.'s at Wilton, Monsanto's at Ruabon, and Dunlop's near Birmingham—by next year Britain's annual capacity for synthetic rubber should reach, say, 70,000 tons. Monsanto Chemicals has started work on its 10,000 tons a year polythene plant near Fawley as part of its $23.8 million petroleum chemicals manufacture program.

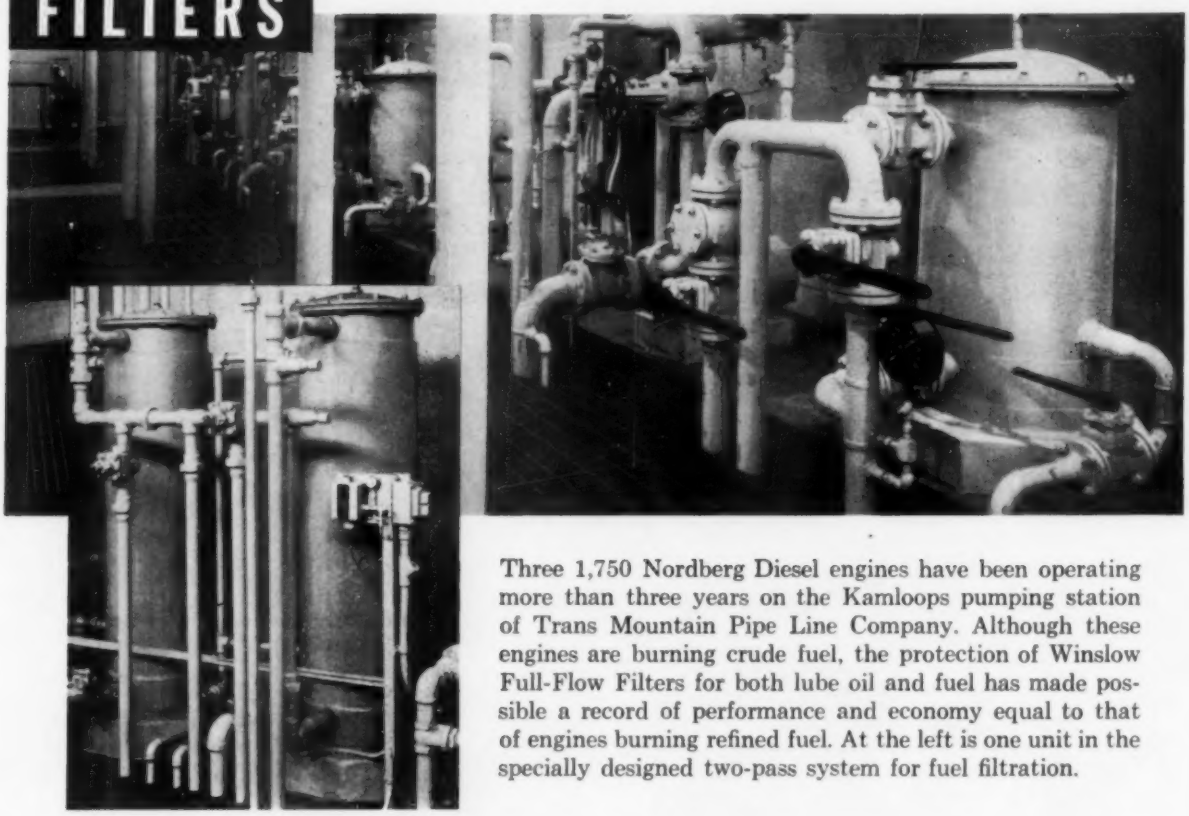
Acrylics . . . Britain's interest in acrylics recently induced the Chemstrand Corp., with its works in Alabama and Florida to form a U. K. subsidiary to produce Acrilan fiber, based on acrylonitrile, in this country in about 18 months' time. Domestic prices of this new fiber are expected to be cheaper than those of Terylene or nylon.

Du Pont

Finally, the Du Pont Co. (U. K.), subsidiary of E. I. du Pont de Nemours of America, has taken option on a 380-acre site adjoining Londonderry, Northern Ireland, as prospective site for a neoprene synthetic-rubber plant. Its construction is to start early this year. A new jetty is being built in Lough Foyle for shipping the company's products. And the site for an envisaged $7,000,000 electricity station was shifted from a municipal park in Londonderry to a location adjoining the new factory. **End.**

WINSLOW *Full-Flow* FILTERS

Case History Report No. 34 Shows Why Engines Protected by WINSLOW FILTERS Last Longer



Three 1,750 Nordberg Diesel engines have been operating more than three years on the Kamloops pumping station of Trans Mountain Pipe Line Company. Although these engines are burning crude fuel, the protection of Winslow Full-Flow Filters for both lube oil and fuel has made possible a record of performance and economy equal to that of engines burning refined fuel. At the left is one unit in the specially designed two-pass system for fuel filtration.

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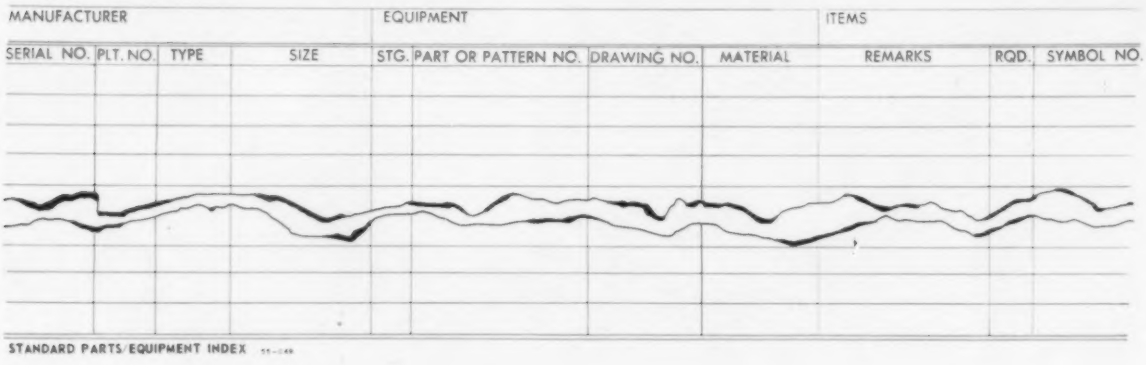
DODGE

PowerGiants

MOST POWER OF THE LOW-PRICED 3



This spare-parts index (Fig. 1) eliminates duplication as . . .

Interchangeability Slices Parts Inventory

Esso has compiled data books at Baton Rouge which list parts on gas-engine compressors and centrifugal pumps. Manuals show where parts may be interchanged. Result has been reduction in spare-parts inventory and improved requisitioning procedures.

By Larry Resen
District Editor

PARTS interchangeability manuals have helped reduce the volume of spare parts being stocked at Esso Standard Oil Co.'s Baton Rouge refinery. They also have contributed to an orderly and economical procedure for the procurement of new parts.

The manuals have been drawn up on gas-engine compressors and centrifugal pumps. On these two groups alone, it has been possible to reduce the spare-parts inventory by $375,000. Inventory reduction on parts for the 2,400 centrifugal pumps at the plant amounted to $225,000 on about 23 per cent of the total inventory of centrifugal-pump parts.

The manuals, or "Standard Parts-Equipment Indexes," are set up to show interchangeability of parts on equipment from the same manufacturer. The complications in coordinating between manufacturers are too great to lend themselves to this treatment.

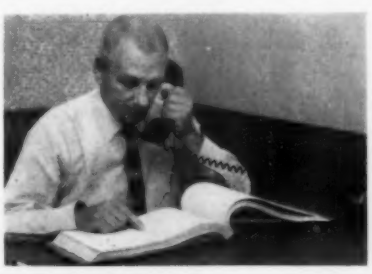
Standard forms were printed upon which specific data could be entered. These forms (Fig. 1) list the manufacturers, equipment title and items, such as A.B.C. Co., compressor, and pistons, respectively.

These forms were then filled out for each individual piece of equipment. This involved a considerable amount of detail. It required the checking of the manufacturers bill of materials on each item, checking the name-plate data, and the recording of pertinent data. Once this data had been recorded, the difficult job of crosschecking was begun.

Crosschecking . . . Each part was checked against the others listed in the same category to see which could be interchanged. Thus, all pump vanes were crosschecked and where the same ones could be used in different pumps, this was noted. Where the same rings might be used on two or more different compressor pistons, a notation also was made. The final forms were filled out with interchangeability notations made part of the permanent record. These forms were compiled in book form and issued to field, shop, and stores personnel.

With this groundwork completed, an evaluation was made of the number of spare parts required in stock. In the past, it was quite common for a compressor or pump to be installed in Unit A and a complete set of spare parts ordered for it. The identical pump or compressor might then be ordered for Unit B, and similarly a complete set of spare parts also ordered for it. Additionally, it was common for a new model to have many parts in common with an older model. Likewise, a four-stage model would have many parts identical with those in a two-stage model. If complete sets of parts were ordered for each of these, it is quite simple to see how a multiplicity of spare parts could easily be acquired.

With the information and data readily available on the compressors and centrifugal pumps, the next logical step was to see how many spare parts were needed. This study pointed out where the same part was being stored on an individual basis for several pumps or compressors. Many identical parts were found in storage, whereas the yearly demand from the entire plant only amounted to two or three. It was feasible in situations such as these to cut back on the inventory to a more practical volume.



W. H. MERCIER refers to a spare-parts manual at Esso Standard's Baton Rouge refinery.

GENERAL VIEW of a storehouse at the Baton Rouge refinery of Esso Standard Oil Co.

An educated guess was made to begin with, and adjustments made as indicated. Thus, if the cutback were too severe and not enough parts were on hand when needed, then the stock would be increased. Likewise, if too many parts were still found on hand, the number of parts would be reduced further.

The impact of these moves to reduce stock will be felt more in the future. This is because many spare parts which accumulated during the years had become virtually worthless. They had little or no trade-in value. Their numbers could be reduced in some instances by cutting back on new orders and working the stock down to a realistic level. However, with many items there was little likelihood that all of them would be consumed gradually in the normal course of events. These have represented almost a total loss. The present system will function to prevent a recurrence of this unintentional and uneconomical stockpiling.

The interchangeability data has been compiled in book form and issued to personnel concerned. When a new piece of equipment is ordered, the spare parts list can be double-checked against the compiled data. Where identical parts already are being stored for other models, these parts automatically will be eliminated from the new spare parts being ordered for the new equipment. Thus, only those parts not common to any other in stock will be ordered.

A VIEW of a storehouse at the refinery showing compressor pistons on pallets.

Dual role . . . The parts books play another important role. They prevent the confusion which often crops up when spare parts are requisitioned for a particular refinery job. For instance, it is not unusual for an O-ring to be referred to as a washer or as a disk, depending on individual interpretation. Where a requisition is filled out for an O-ring with just the manufacturer's serial number, a bit of confusion can creep in. If the word washer or disk is inserted instead of O-ring, the confusion in the stockroom can be expected to mount. This not only entails a slowdown, and results in considerable correspondence between the stockroom and the job, but also disrupts an even, orderly flow of supplies to a job.

A reference to the manual can eliminate this. Each part is listed not only with its serial number, but also with the refinery storeroom stock number. This latter notation on a requisition insures the correct part will be supplied.

The interchangeability of parts idea was extended to permit some standardization with respect to metallurgy. For instance, several identical pumps are in service which require different metals for various parts, such as impellers. These services were revised in the over-all evaluation studies. Where practical, the part was only stocked in one metal, which would be suitable for the several services. Thus, a bronze impeller will work where a cast-iron impeller is specified. A chrome impeller, meanwhile, is satisfactory for any service requiring bronze or simply cast iron. Naturally, consideration was given to the increased cost of the higher grade metal. This differential had to be offset by the advantage in standardization on the parts and cutting down on the inventory before the switch was made.

Acknowledgment

Cooperation of the management of Esso Standard Oil Co. is gratefully acknowledged as in the assistance of A. C. Worsley and W. H. Mercier.

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Mud Capacity
(at 20 psi operating pressure)

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#4 D-Sander — 400-500 gpm

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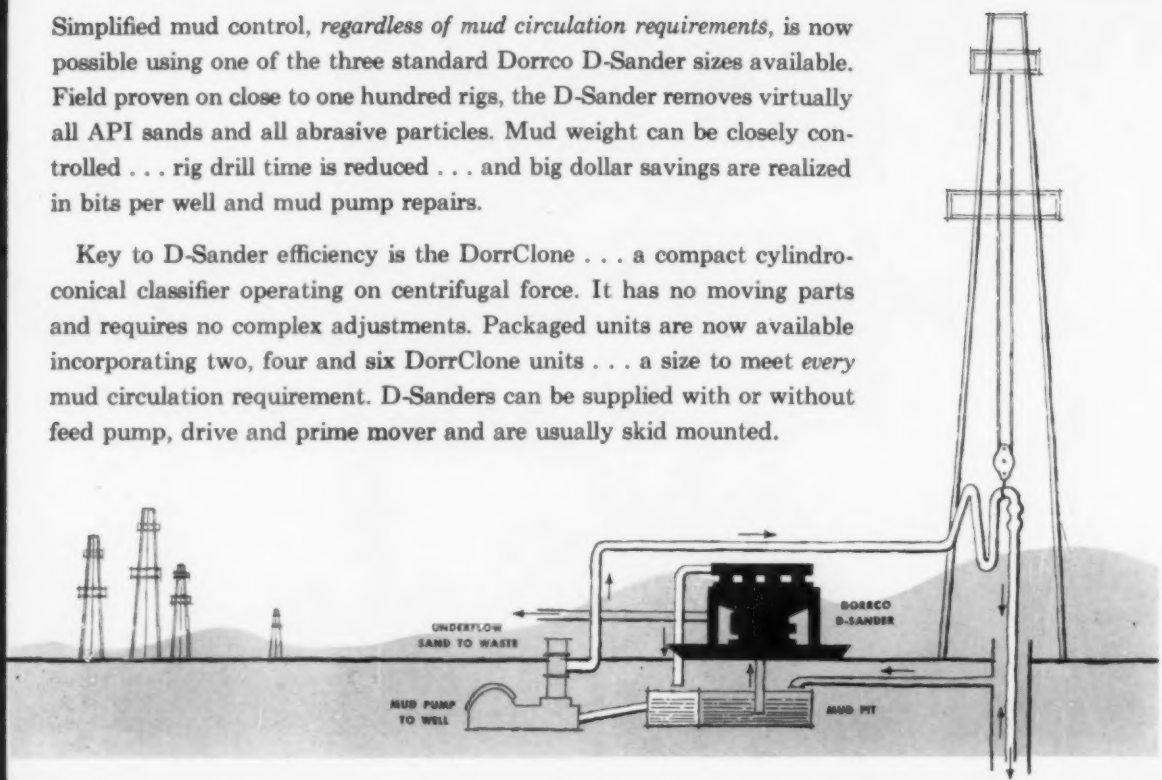
Simplified mud control, *regardless of mud circulation requirements*, is now possible using one of the three standard Dorrco D-Sander sizes available. Field proven on close to one hundred rigs, the D-Sander removes virtually all API sands and all abrasive particles. Mud weight can be closely controlled . . . rig drill time is reduced . . . and big dollar savings are realized in bits per well and mud pump repairs.

Key to D-Sander efficiency is the DorrClone . . . a compact cylindro-conical classifier operating on centrifugal force. It has no moving parts and requires no complex adjustments. Packaged units are now available incorporating two, four and six DorrClone units . . . a size to meet *every* mud circulation requirement. D-Sanders can be supplied with or without feed pump, drive and prime mover and are usually skid mounted.



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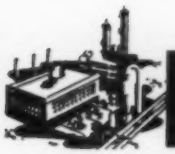
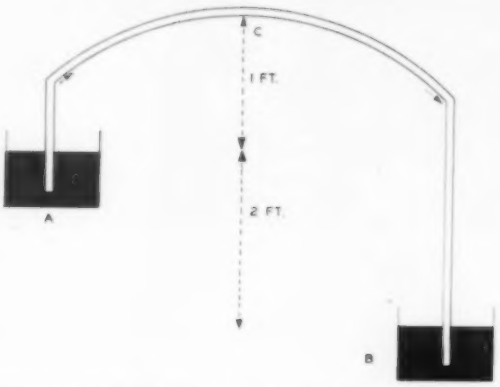


THE FOREMAN'S PAGE

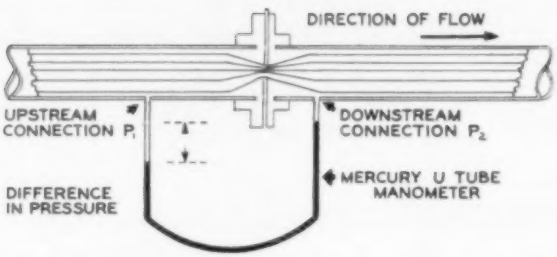
Refining • Petrochem • Natural Gasoline

JOB IMPROVEMENT FOR THE PROCESS FOREMAN—95

How Gas and Liquid Flow Are Measured



SIPHON OPERATION is shown here. Since the upward force at A is greater than at B, the flow will be from A to B. Fig. 4.



THIS DRAWING shows the use of differences in pressure as the basis for measuring flow. Fig. 5.

A FLUID will move from one location to another unless the flow is restrained or until the fluid reaches its own level. The siphon, however, at first glance appears to be an exception to the rule. A closer study of just how the siphon works shows that it really is no exception. Fig. 4 indicates the operation of a siphon.

The siphon is a bent tube with branches of unequal length open at both ends and is used to move a liquid from a higher point to a lower point, over an intermediate point higher than either. This action shows the effect of atmospheric pressure. Suppose the tube is filled with water and placed in the vessels as shown in Fig. 4. The water will flow from vessel A to vessel B as long as the level in vessel B is below that in vessel A and the level in vessel A is above the lower end of the connecting tube.

The pressure against the water in vessels A and B is the atmospheric pressure or 14.7 lb. per sq. in. When the tube is full of water, the water in the branch CA would tend to be held up by the atmospheric pressure. The pressure of 1 ft. of water is 0.433 psi. This is the downward pressure. The upward pressure is 14.7 psi. The new upward pressure at vessel A is $14.7 - 0.433 = 14.267$ or 14.3 psi. The water in branch CB exerts a downward pressure on the water in vessel B of 3×0.433 or 1.299 psi. The upward pressure of the atmosphere is 14.7 psi. The net upward pressure at vessel B is $14.7 - 1.299 = 13.401$ or 13.4 psi.

This material taken from process-training-program manual, Baton Rouge La., refinery of Esso-Standard Oil Co.

Flow of gases . . . Gases, like liquids, move as a fluid. However, gases differ from a liquid in that gases are compressible while liquids are not. This characteristic is most important in the movement of gases. In the movement of liquids, if we are pumping at the rate of 6,000 bbl. per day and doubled the pressure on the system, the volume through the line would not be affected because liquids are not compressible. Regardless of the pressure, the volume would still be 6,000 bbl. per day. If, however, we were moving gas through a line at the rate of 1 M.M.c.f. per day and we doubled the pressure, the volume of gas would be reduced from 1,000,000 to about 500 M.c.f. per day. Some of the ways in which the compressibility of gas affects refinery operations are:

1. Increased pressure means reduced equipment size.

2. Gas, such as air, under pressure can be used to operate pneumatic tools.

3. Hydrocarbon gases such as propane or butane can be compressed, liquefied, and sold as L.P.G.

4. Certain gases can be compressed until they liquefy and then can be expanded again to produce refrigeration.

How fluids are measured . . . Pressure energy can be converted into velocity energy. When pressure is converted to velocity, the pressure is reduced. This difference in pressure between two points in the line of flow is the principle on which the common flow meter operates.

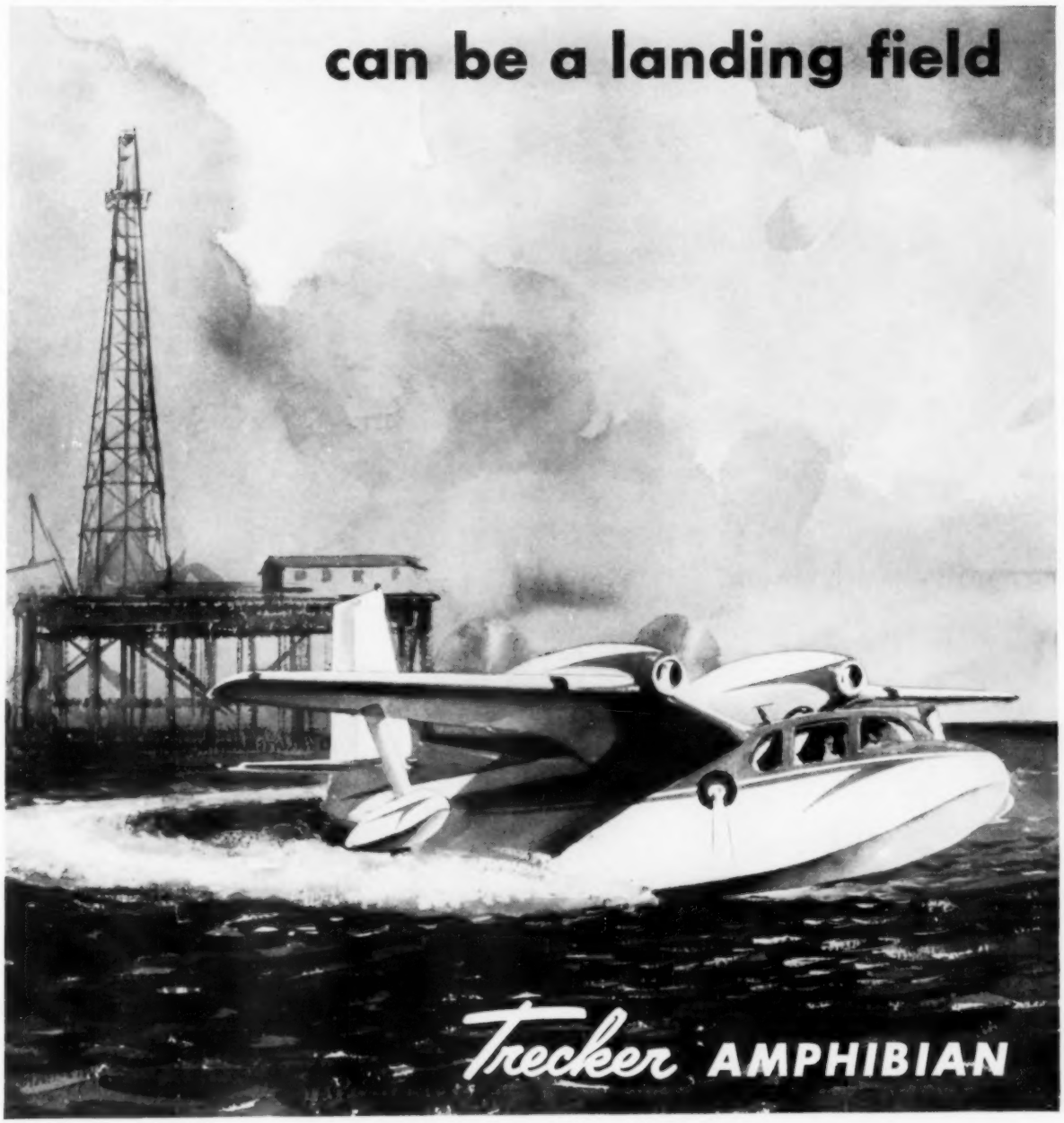
The manpower shows the upstream pressure P_1 is higher than the pressure, P_2 downstream from the orifice plate. The difference between pressure P_1 and P_2 is a measure of the flow through the orifice plate. Increase the flow through the line and the velocity through the orifice plate will be higher. The difference between P_1 and P_2 would be greater. It is this difference in pressure that is the basis for calculating the rate of flow (Fig. 5).

Summary

Movement of fluids is important in refinery operations because that is the way most materials are moved. Movement of solids presents a problem in that they require mechanical conveyance unless the solid is taken into solution or fluidized and caused to behave as fluid. From the standpoint of costs, the movement of fluids generally is much cheaper than the movement of solids. **End.**

Any Airport, Lake, or River...

can be a landing field



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This man knows why

MISSION LINERS

cut both piston and liner costs

THIS MAN IS CHECKING both the hardness and thickness of the hardened area of the bore of a test sample from a Mission Super-Service® Slush Pump Liner. His findings are reproduced in graph form *below*.

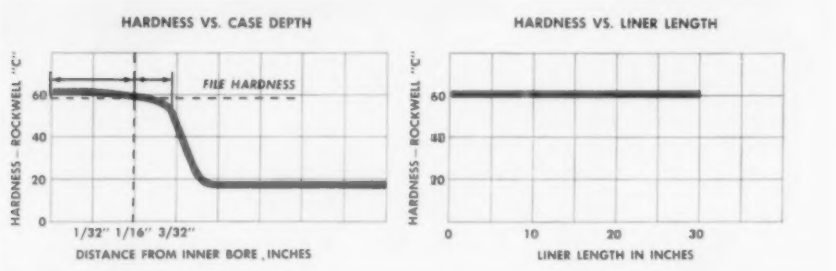
This means that Mission Liners wear slowly *throughout their entire life*. They wear far longer than some liners which start out wearing slowly, but "give up" fast after the thin case is worn off and softer metal is reached.

The graph *at the right* shows that hardness and depth of hardness are perfectly uniform throughout the length of the liner. There are no soft spots to wear unevenly.

It's not easy to get uniformity like this. It takes the finest and most modern induction hardening equipment, plus a lot of care and metallurgical skill—elements not available to some manufacturers.

Although liners may look a lot alike, there are big differences that don't meet the eye. Some are flame hardened, some are carburized and some utilize other special techniques. Mission has tested many liners made by various methods but found nothing to produce results like those obtained from induction-hardened Mission Super-Service Liners.

Play it safe! For the best in slush pump performance specify MISSION when you order liners from your supply stores. You will save money and trouble when you do.



This graph shows that Mission Liners have a true "File Hard" bore throughout the useful wearing depth of 1/16". This means long liner life.

This graph illustrates that hardness is absolutely uniform throughout the wearing area of the liner. This means uniform slow wear.

Nothing but the finest will bear the name of MISSION MANUFACTURING CO.

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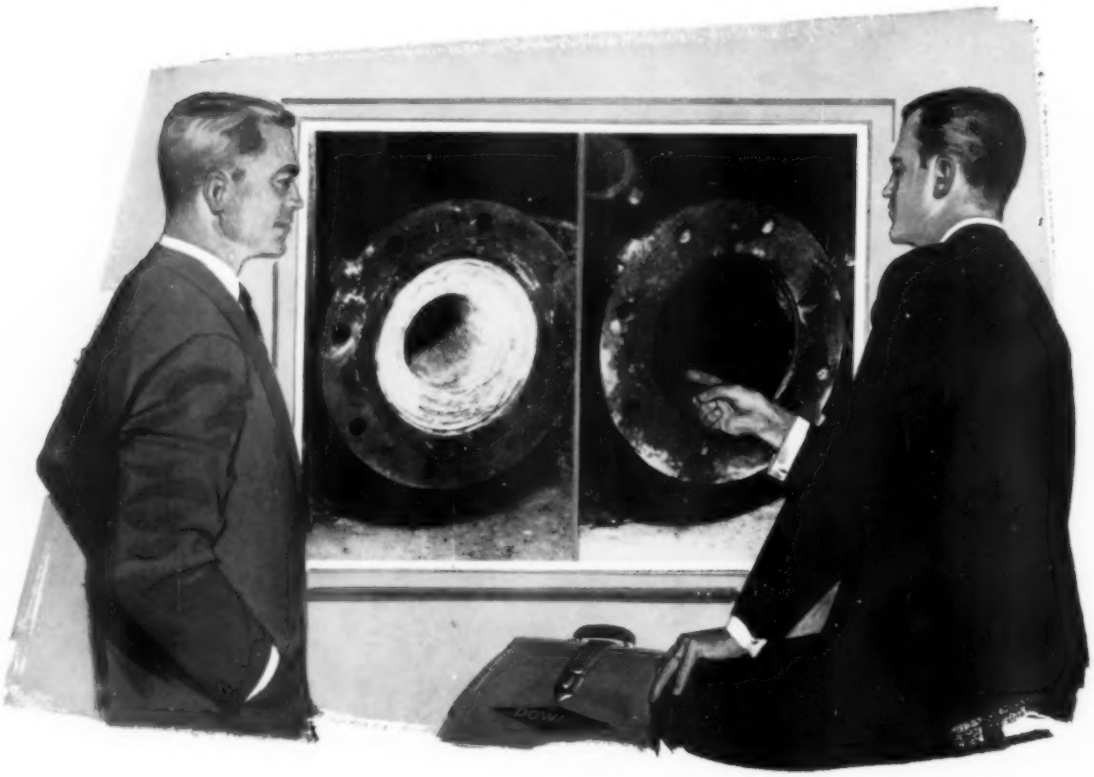
here's how Dowell chemical cleaning saved $71,000 and helped protect a plant profit!



A few months before their peak season, the operators of this plant decided their main water line might not supply the water necessary to meet peak demands. The line was cast-iron, 16-inches in diameter and over 7,000 feet long. Its original flow efficiency or "C" factor had been 105; scale build-up had reduced this to 72. To lay an auxiliary line would cost at least $85,000.

Dowell contracted to clean the pipe chemically for a little less than $14,000, and to restore a minimum of 50 per cent of the line's lost capacity.

This Dowell did, and more—increasing the "C" factor to 92! Enough water was immediately available for capacity operation. This saved the plant $71,000 and helped protect the company's annual profit.

The operating credit realized by this food processing plant, as a result of Dowell service, is similar to those realized by other Dowell customers—in the steel, paper, chemical, oil refining, power and allied industries.

Dowell engineers are experts in the use of solvents to remove scale and sludge—deposits that cut the throughput of product, process and steam generating systems. Dowell does the job, furnishing all chemicals, trained personnel, pumping and control equipment.

For specific information on how chemical cleaning can help you to greater profits, call the Dowell office nearest you. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

Have Dowell clean it chemically **DOWELL**

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

COST-imating

34. Summarizing the Cost of Refineries

By W. L. Nelson
Technical Editor

FACTORS that vitally affect the cost of a refinery are:

1. Size (see Cost-imating No. 27, April 1, 1957, p. 204).

2. Octane Number of Gasoline (see Cost-imating No. 31, May 27, 1957, p. 155).

3. Amount of Lube Oil (see Cost-imating No. 31).

4. Location (see Cost-imating No. 33, June 24, 1957, p. 174).

5. Sulfur or Sourness of Crude Oil.

6. Gravity of crude oil.

All of these have been introduced except items 5, (Sulfur and Sourness) and 6, (Gravity), and the effect of all of the factors is summarized in Table 2 on this page. Date of construction is obviously significant, but this influence can easily be introduced by the Nelson Refinery Construction Cost Index (first issue each month of The Oil and Gas Journal).

A corrosion study group of the American Petroleum Institute estimates that built-in corrosion resistance in refineries constitutes 13 per cent of the plant cost. Most of this cost is for resistance to sourness (free hydrogen sulfide) and to sulfur. Still another source (Winslow and Weikart, A.P.I. meeting, St. Louis, May 11, 1955) based on a large somewhat simple fuel-type refinery indicates an extra built-in corrosion cost (plus hydrogen sulfide removal from light ends and gas) which amounts to 10 per cent. If Hydrofining is also included, the extra investment is much more (approaching 77 per cent) but this, of course, involves improvement in product quality. Finally, McLean and Haigh (The Growth of Integrated Oil Companies, p. 581, Harvard School of Business, 1954), show a 48 per cent greater plant cost (1950) for a refinery that processes sour West Texas crude rather than a light sweet crude oil. The factors of Table 1 are based on an extra investment cost of only 15 per cent.

The effect of crude-oil gravity is indicated in Table 2. These plants were designed for 86 research octane number (with 2 cc. TEL) gasoline.

TABLE 1—APPROXIMATE EFFECT OF SULFUR AND SOURNESS ON REFINERY COST*
(Applies only to Process Units Cost)

	Factor (multiplier)	
	Sweet	Sour†
Below 0.6% S	0.88	0.94
0.6-1.0% S	0.96	1.02
1.0-1.5% S	1.03	1.10
Over 1.5% S	1.08	1.14

*Not including hydrodesulfurization for product improvement.

†Dissolved hydrogen sulfide, over 0.5 cu. ft. per 100 gal.

TABLE 2.—SUMMARY OF 1946* REFINERY COSTS TO INDICATE RANGES
(All crude oils are "sweet" except as indicated.)

Type of Refinery	Capacity B.P.D.	Refinery cost, $ per daily bbl., 1946*: U.S.A. refinery proper	Outside U.S.A.: Refinery proper	Outside U.S.A.: Including related installations†
Lube-type—25% lubes	30,000	$1,110	$1,080-1,820	$1,080-4,390
Lube-type—20% lubes	30,000	1,000	975-1,640	975-3,950
Lube-type—15% lubes	30,000	880	857-1,440	857-3,480
Lube-type—10% lubes	30,000	754	725-1,235	725-2,980
Average (1956) U.S.A. (0.8%S)	30,000	593	578- 972	578-2,345
under 0.6%S in crude	30,000	543	530- 891	530-2,140
0.6-1.0%S in crude	30,000	576	561- 945	561-2,220
1.0-1.5%S in crude	30,000	606	591- 995	591-2,340
over 1.5%S in crude	30,000	627	611-1,030	611-2,410
small (0.8%S)	10,000	652	636-1,070	636-2,580
large	100,000	522	510- 855	510-2,060
very large	300,000	462	451- 758	451-1,830
Fuel-type—70 Oct. with 2 cc. TEL	30,000	290	283- 475	283-1,148
Fuel-type—80 Oct. with 2 cc. TEL	30,000	400	390- 656	390-1,580
Fuel-type—90 Oct. with 2 cc. TEL	30,000	543	530- 890	530-2,150
Fuel-type—94 Oct. with 2 cc. TEL	30,000	620	605-1,017	605-2,450
Fuel-type—97 Oct. with 2 cc. TEL	30,000	700	683-1,148	683-2,770
Fuel-type (Simple), 15 API crude	100,000	232	226- 380	226- 917
Fuel-type (86 Oct.) 20	100,000	268	262- 440	262-1,060
Fuel-type 25	100,000	304	296- 498	296-1,203
Fuel-type 30	100,000	344	336- 564	336-1,360
Fuel-type 35	100,000	384	375- 630	375-1,520
Fuel-type 40	100,000	405	395- 665	395-1,600
Fuel-type (Simple), under 0.6%S	100,000	360	351- 591	351-1,420
(but sour)	100,000	370	361- 607	361-1,460
0.6-1.0%S in crude	100,000	376	367- 617	367-1,485
(also sour)	100,000	388	378- 637	378-1,530
1.0-1.5S in crude	100,000	390	380- 640	380-1,540
(also sour)	100,000	404	394- 663	394-1,595
over 1.5%S in crude	100,000	400	390- 657	390-1,580
(also sour)	100,000	412	402- 675	402-1,630

*Convert cost to other years by Nelson Refinery Construction Cost Index. During 1956, the Index was 195.6. †Maximum costs in part required for adequate housing, sanitation, etc., but also they constitute another way of paying the foreign government for the concession.

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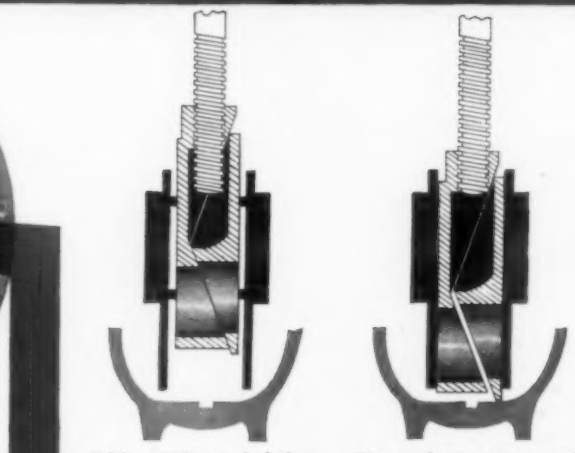

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This force is applied simultaneously and equally to both seats. It is controlled by the torque applied on the valve stem. It is not and cannot be applied while gate is moving, because the gate and segment are held in a collapsed, free-moving position by means of alloy steel gate springs.

When the gate and segment reach closing position, the segment stops while the gate continues to move downward, forcing both the gate and segment against the two seats. The tighter the valve is closed, the greater the sealing force applied to the upstream and downstream seats.

When the valve is opened, torque on the valve stem releases the sealing force so that the gate and segment move freely to a fully open position.

With W-K-M's "CONTROLLED FORCE" seating, you always have a leakproof seal upstream and downstream.

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By J. G. Burnham

Part 1 of a New Series

Which Nitrogen-Removal Method Is Best?

THE subject of nitrogen removal from natural gas has been discussed in the journals and magazines of the industries in the past several years. At least one or more conferences and discussions has been held by interested members of the oil and gas organizations also to review the problems and methods of coping with nitrogen and other inerts of gas.

From these papers, articles, and discussions have emerged a number of methods or suggested processes for use. These can be classified in broad terms as absorption, adsorption, centrifugal, diffusion, hydrate formation, and low-temperature refrigeration. Certain of these processes have practical and commercial application.

In the past 8 years we have had opportunity to engage in the design, engineering, and estimating of three actual plants for removing nitrogen from field gas. Although not a one of these designs has been built, we believe that each instance in its successive order has added to our knowledge and know-how and today we are sure that the designed installation would function very close to the predicted and required conditions.

Low-temperature operations . . . For the first design and for all of the subsequent ones, we tried to use and accumulate the best sources of knowledge, with the advice and counsel of those who had years of experience in rare gas recovery and other low-temperature operations. Of the processes available, low-temperature refrigeration and fractionation was selected principally because this method seemed to have the best promise of good economics and because others of the suggested list were not practical. It was also not possible to examine all of the suggested processes because of the time and expense that would be required.

Author is with Stearns-Roger Manufacturing Co. Paper presented at N.G.A.A. annual meeting, Houston, 1957.

Process

All three of the plants were designed and estimated using refrigeration for liquifying the gas stream using temperatures ranging from —150° to 210° F. The final separation of nitrogen from methane was by fractionation.

It is my opinion that in the early designs small gas streams were "chased" too hard for the recovery of heat. By ignoring these streams and adding additional and supplemental refrigeration perhaps the capital investment might have been lowered.

Certain features of the design used for the three plants are classified, not in a governmental sense, but to protect the rights and interests of the participating companies which contributed time and money to the projects. Instead of enlarging further upon the design used, it is interesting to turn to the economic side of nitrogen removal plants, and learn why not one has been built.

Table 1 presents the pertinent information of gas volumes, percentage of nitrogen extracted, upgrading of heating value, investment, and daily income and expense.

TABLE 1

	Plant 1A	Plant 1B	Plant 2	Plant 3
Raw-gas volume, M.M.s.c.f.d.	100	100	70	50
L.P.G. production, gal. per day				24,000
Propane production, gal. per day	85,600	87,400	48,000	
Butane production, gal. per day	32,600	32,600	14,000	
26-70 production, gal. per day	31,600	31,700	21,000	
32 R.v.p. production, gal. per day				24,300
Purified-gas volume, M.M.s.c.f.d.	76.6	71.9	36.58	36.93
Inlet, gross B.t.u. per cu. ft.	991	991	700	841
Outlet, gross B.t.u. fer cu. ft.	975	1,059	965	1,000
N_2 removed, per cent	54.5	90.3	98.7	80.8
Daily income—				
Gas sales at 20c per M.c.f.	$15,920	$14,380	$7,316	$7,386
Fuel M.c.f. at 20c per M.c.f.	432	365		
Propane sales at 5c per gal.	4,280	4,370	2,200	
Butane sales at 3c per gal.	978	978	420	
26-70 sales at 4c per gal.	1,264	1,264	840	
L.P.G. sales at 5c per gal.				1,200
32 R.v.p. at 3.5c per gal.				851
Total daily income	$22,871	$21,357	$10,776	$9,437
Daily expense—				
Raw-gas cost at 20c per M.c.f.	$20,000	$20,000	$14,000	$10,000
Fuel cost at 20c per M.c.f.	960	1,300	709	795
Maintenance, gen. supplies, water-treating, chemicals				
Labor and supervision	1,042	1,042	799	1,112
Total daily expense	$22,002	$22,342	$15,508	$11,907
Gross daily operating—	Profit	Loss	Loss	Loss
Profit or loss	$872	$985	$4,732	$2,470
Gross operating profit per year	$318,280			
Capital investment	$16,800,000	$19,100,000	$12,300,000	$7,900,000
Fixed charges—				
Amortization, 15 years	$1,120,000	$1,273,000		
Avg. interest at 3.5 per cent per year on half of investment	294,000	334,350		
Taxes and insurance at 1.25 per cent	210,000	238,750		
Total fixed charges	$1,624,000	$1,846,100		
Operating loss	$1,305,720			
Payout basis—				
Gross operating profit per year	318,280			
Interest, taxes, and insurance	504,000			

Storage Stability

Comparison of Distillate Fuel in Storage

By F. G. Schwartz and C. C. Ward

COMPLETE tables of data from the storage of the 34 distillates and 250 distillate blends that were used in this program are available in the W.P.R.A. report. Table 2 of the text (see pages 30 and 31 of the report) is listed here as Table 1 of this series.

Unblended Fuels

Storage data for the 34 unblended fuels support the following statements:

Straightrun fuels . . . The straightrun fuels in general are more stable than either the catalytically cracked or the thermally cracked fuels; however, under certain conditions, such as storage with contaminants, an increase in gum formation is noted as compared with the fuel stored neat.

Catalytically cracked fuels . . . The catalytically cracked fuels in general are intermediate between the straightrun and thermally cracked fuels in regard to gum formation in 110° F. storage. However, some are more stable than some of the straightrun fuels.

Thermally cracked fuels . . . The thermally cracked fuels showed much larger increases in gum content than either the straightrun or catalytically cracked fuels, and four of them (one from West Texas, one from the Gulf Coast, and two from California) were unstable at all conditions of storage.

Authors are with Petroleum Experiment Station, Bureau of Mines, USDI, Bartlesville, Okla.

TABLE 1—INITIAL PROPERTIES OF 34 DISTILLATE FUELS USED FOR STORAGE STABILITY WORK

Sample No.	Fuel description—	Light transmission, per cent	Boiling range, °F.			Gum, mg./100 ml.		Specific gravity, 60/60 °F.	Aniline point (°F.)	Bromine No.	Total sulfur weight per cent
			I.b.p.	50%	E.p.	Insoluble	Soluble				
	Straightrun:										
101	W. Mid-Continent	99.5	372	494	601	0.1	1.3	0.8224	159.1	1.2	0.07
108	E. Mid-Continent	87.1	375	351	661	0.7	3.4	0.8425	160.4	3.5	0.18
113	Gulf Coast	98.8	468	538	634	0.5	nil	0.8344	173.1	2.4	0.10
118	W. Texas	95.4	308	545	697	0.5	1.7	0.8573	151.5	9.2	0.76
123	California (1)	38.4	382	495	672	0.9	6.9	0.8610	127.9	6.1	0.34
124	California (2)	34.6	410	510	675	1.0	6.6	0.8690	134.0	7.1	0.70
132	Rocky Mountain	91.9	422	550	624	0.3	1.0	0.8512	157.0	6.2	1.02
137	Scurry County, Texas	99.5	402	483	597	0.4	nil	0.8366	148.3	5.6	0.14
140	Middle East	99.3	449	558	638	0.2	0.6	0.8428	163.8	6.3	1.28
143	Venezuelan	87.2	383	520	650	0.5	1.8	0.8532	149.0	7.8	0.38
146	Mexican (1)	45.9	426	577	677	1.3	10.9	0.8489	167.0	10.0	1.13
167	Mexican (2)	82.1	452	536	620	1.0	5.5	0.8372	162.2	7.0	1.18
168	Canadian	98.9	452	492	585	0.9	1.6	0.8440	146.0	4.0	0.36
	Thermally cracked:										
102	W. Mid-Continent	85.5	399	486	607	0.2	2.9	0.9228	50.4	25.6	0.45
109	E. Mid-Continent	62.0	326	512	654	0.3	1.4	0.8540	136.0	22.1	0.36
114	Gulf Coast	62.6	372	446	584	0.3	1.8	0.8604	104.2	27.4	0.11
119	W. Texas	43.2	410	451	510	0.3	16.2	0.8684	93.2	44.8	0.80
125	California (1)	25.2	332	436	574	0.3	1.9	0.8430	109.0	56.1	1.18
126	California (2)	0.1	372	528	694	0.7	19.4	0.8910	109.7	38.7	1.19
133	Rocky Mountain	71.3	150	507	646	0.1	2.9	0.8946	85.0	27.1	2.10
169	Canadian	69.3	398	471	604	0.4	3.3	0.8700	41.0	17.3	0.46
192	Mexican		186	422	530	0.4	4.1	0.8392	96.8	34.5	0.85
	Catalytically cracked:										
103	W. Mid-Continent (1)	85.6	468	586	694	0.2	1.6	0.8793	146.7	15.3	0.33
104	W. Mid-Continent (2)	96.7	461	540	630	0.1	1.6	0.8891	122.0	5.8	0.34
110	E. Mid-Continent	93.4	360	506	597	0.2	3.3	0.8595	133.5	17.1	0.21
115	Gulf Coast	97.6	456	522	624	0.1	nil	0.8773	129.2	27.4	0.09
120	W. Texas	93.4	460	555	656	0.5	2.5	0.8985	123.3	15.7	0.86
127	California (1)	65.9	444	556	672	0.7	10.6	0.9090	110.6	17.4	0.85
175	California (2)	42.9	436	542	658	1.0	6.5	0.9070	104.0	19.3	0.93
134	Rocky Mountain	92.0	437	517	634	0.1	1.0	0.9298	62.2	16.7	2.33
138	Scurry County, Texas	83.9	474	561	650	0.2	5.5	0.8897	133.0	10.8	0.26
141	Middle East	94.2	412	502	634	0.1	2.3	0.8780	124.0	11.2	0.66
144	Venezuelan	80.8	440	558	656	0.5	3.3	0.9180	98.0	21.3	0.80
170	Canadian	48.6	448	552	678	3.3	7.9	0.8880	129.0	13.5	0.48

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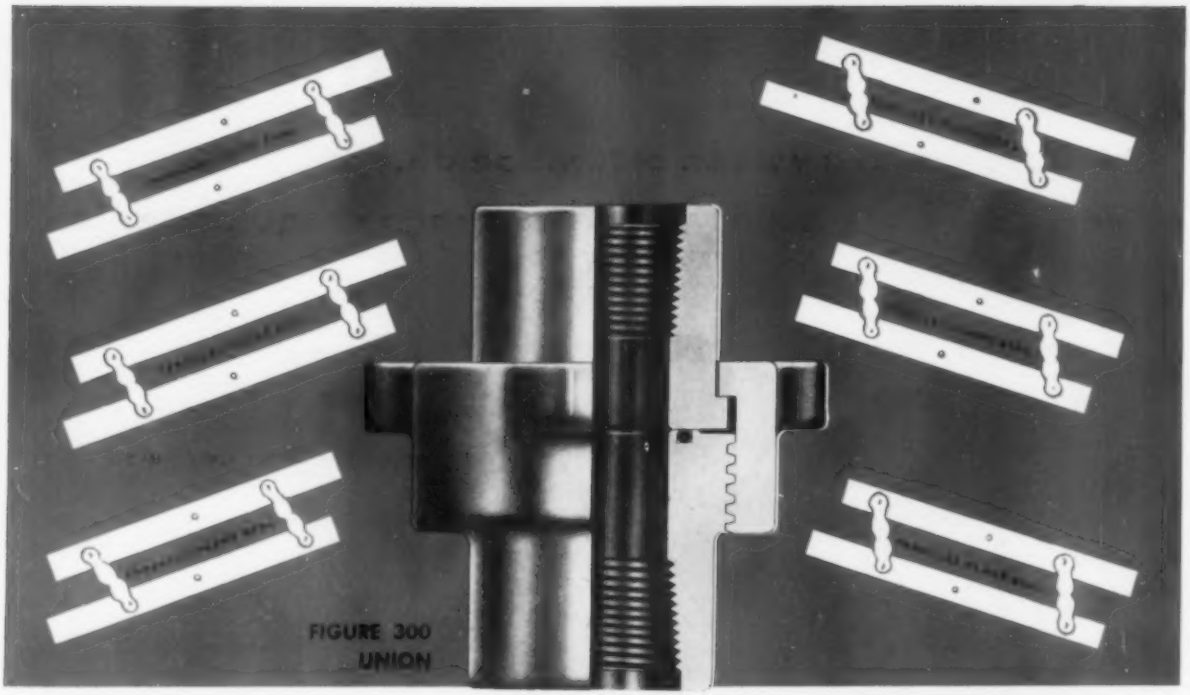

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Pipeline Patrol

... Report on Construction

PIPELINE activity reported here is compiled from surveys conducted by The Oil and Gas Journal among pipeline companies and contracting firms. Projects listed include those proposed, contracted, and under way.

U.S. Crude-Oil Pipelines

- **Cape Pipe Line Co.** (organized by Sun Oil Co., Cities Service Co., Atlantic Refining Co.)

Project: Line from lower Delaware Bay to Philadelphia.
Status: Long range plans.
Completion: 1960.

- **C.A.T.C.** (Continental Oil Co., Atlantic Refining Co., Tidewater Oil Co., Cities Service Production Corp.)

Project: 19 miles of 12-in. from Grand Isle, La., to Platform A in Block 47 field in Gulf of Mexico, plus four 5-mile sections of 8-in. to three other platforms in Block 47 and one in Block 40.
Status: Under way.
Contractor: **Marine Gathering Corp.**
Completion: September 1, 1957.

- **Four-Corners Pipe Line Co.** (newly formed by Shell Oil Co., Standard Oil Co. of California, Continental Pipe Line Co., Gulf Oil Corp., Richfield Oil Corp., Superior Oil Co.)

Project: 635 miles of 16-in. from Aneth field in southern Utah to Los Angeles, 86 miles of 12-in. from New Mexico's Bisti field to Red Mesa station 35 miles southeast of Bluff, Utah, and 3 miles of 6, 8, 10-in. feeder lines from other fields in New Mexico and Utah. Line will be operated by Shell Pipe Line Corp. as agent for the companies.
Status: Under way.
Contractor: **A. P. Vaughn Construction Co.**, Fort Worth, and **Potashnick Construction Co.**, Cape Girardeau, Mo., will jointly build 170 miles of 16-in. from Aneth field to Cameron, Ariz. **R. H. Fulton Construction Co.**, Lubbock, Tex., will build 98 miles of 16-in. from Cameron to Seligman, Ariz., and 217 miles of 16-in. from the Colorado River to Olive, Calif. Remainder not let.
Completion: End 1957.

- **Fulton, R. H. & Co.**, Lubbock, Tex.

Project: 39 miles of 6-in. in Wyo., from Donkey Creek field to Osage pump station in Weston County.
Status: Fulton, a contractor, has applied to Wyoming Public Service Commission.

- **Great Northern Railway Co.**

Project: 400 to 600 miles of 12 to 20-in. from Williston basin in Montana and North Dakota, to Clearbrook or St. Paul, Minn.
Status: Under study.
Contractor: **Pipe Line Technologists, Inc.** has contract for feasibility study to be finished July or August 1957.

- **Interstate Oil Pipe Line Co.**

Project: 5 miles of 4-in. from South Bosco field, Louisiana, to present main line, and 5 miles of various size from Church Point field, Louisiana, to present main line.
Status: Proposed.

- **Magnolia Petroleum Co.**

Project: 203 miles of 12, 16, and 20-in. loops between Midland and Beaumont, Tex.
Status: To start August 1957.
Contractor: **O. R. Burden Construction Corp. has** 121 miles of 16-in. and 5 miles of 12-in. between Midland and Corsicana. **H. B. Zachry Co.** has 77 miles of 12, 16, and 20-in. between Corsicana and Beaumont.
Completion: Early 1958.

- **Muskegon Pipe Line Corp.** (newly formed by Aurora Gasoline Co. and Service Pipe Line Co.)

Project: 165 miles of 10-in. from Griffith, Ind., to Muskegon, Mich.
Status: Planned.
Completion: Late 1957.

- **Northwest Pipeline Corp.** (an affiliate of Pacific Northwest)

Project 80 miles of 8-in. and 300 miles of 10-in. crude and products line from Four Corners area to Salt Lake City.
Status: Proposed.

- **Offshore Gathering Corp., Houston.**

Project: 364 miles of mostly 20-in. in Gulf of Mexico off Louisiana. (Dual line.)
Status: Proposed.

- **Oil Field Pipe Line, Inc.**

Project: 200 miles 8 and 12-in. line from near Elkhart, to Ellinwood, Kans.
Status: Proposed.

- **Pasotex Pipe Line Co.**

Project: 58 miles of 20-in. between Wink and El Paso, Tex.
Status: Under way.
Contractor: **R. H. Fulton & Co.**
Completion: September 1, 1957.

- **Salt Lake Pipe Line Co.**

Project: 100 miles of 10-in. looping of Rangely, Colo., to Salt Lake City line.
Status: Pipe has been ordered.
Completion: Late 1957.

- **Shamrock Oil & Gas Corp.**

Project: 35 miles of 6-in. to serve fields in Ochiltree and Hansford counties in the Texas Panhandle.
Status: Under way.

- **Shell Oil Co.**

Project: Undetermined length of 3, 4-in. in South Louisiana.
Status: Under way.
Contractor: **Brown & Root, Inc.**, W. P. Stanley, spread superintendent, office at Buras, La.
Completion: September 30, 1957.

- **Sinclair Pipeline Co.**

Project: 150 miles of 20-in. from Teague Tex., to Houston.
Status: Planned for 1958.
Completion: 1958.

- **Skelly Oil Co.**

Project: 38 miles of 8-in. extension of its gathering system into southern Kiowa County, Kansas.
Status: Planned.
Completion: Early fall 1957.

- **Southern Kansas Pipeline, Inc.** (newly organized).

Project: 200 miles of 6 to 10-in. from southwestern Meade County to a point in Cowley County, 10 miles north of Arkansas City.
Status: Proposed. Request filed with Kansas Corporation Commission for permit.

- **Tecumseh Pipe Line System** (Joint venture of Sinclair Pipe Line, Ashland Oil & Refining, and Pure Oil Co.)

Project: 201 miles of 20-in. between Griffith, Ind., and Cygnet, Ohio.
Status: Under way.
Contractor: **O. R. Burden Construction Corp.** has two spreads of 93 miles from Griffith eastward and 92 miles from the

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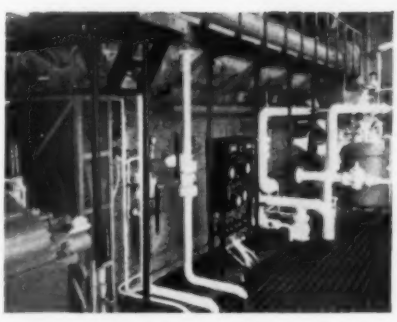

In Gulf Interstate's satellite station near Stanton, Kentucky, this Cooper-Bessemer centrifugal compressor is driven by a 4-cycle Cooper-Bessemer engine operating economically on natural gas from the pipeline.

Pipeline Patrol

mid-point to Cygnet. Remainder not let.
Completion: September 1957.

- **Texas-New Mexico Pipe Line Co.** (owned by The Texas Co., Sinclair Pipe Line Co., Tidewater Oil Co., and Empire Gas & Fuel Co.)

Project: 515 miles of 16-in. from southeast corner of Utah to Jal in southeastern New Mexico.
Status: To start late 1957.
Contractor: Survey contracts went to **J. V. McCoy**, Houston, and **E. H. Schmidt and Associates**, Tulsa.
Completion: 1958.

U.S. Products Pipelines

- **Alaska-Yukon Refiners & Distributors, Ltd.**

Project: Two lines: one 150 miles from Haines to Haines Junction, Alaska, linking with government Canol line; another from Tok Junction, on the Canol line, to Anchorage.
Status: Proposed.
Completion: 1959.

- **American Pipe Line Co.**

Project: Line from Gulf Coast to New York City. Has ODM approval to amortize 40 per cent of cost with fast writeoff.
Status: Proposed.

- **Buckeye Pipe Line Co.**

Project: Conversion of 32 miles of 8-in. crude to products between Mantua, Ohio, and Youngstown area.
Status: Planned.
Contractor: Company will do own work.
Completion: November 1957.
Project: 70 miles of 8-in. from Wayne to vicinity of Durand, Mich.
Status: Under way.
Completion: Early 1958.

- **Cities Service Pipe Line Co.**

Project: 29 miles of 6-in. ethylene line from Lake Charles, La., to Orange, Tex.
Status: Planned.
Completion: July 31, 1957.
Project: 168 miles of 6-in. L.P.G. line from East Chicago, Ind., to Lowell, Mich.
Status: Under way.
Contractor: **Somerville Construction Co.** has 98 miles from Lowell to South Bend, Ind., Robert Hively, spread superintendent, office at Ada, Mich.
Completion: September 1, 1957.

- **Continental Pipe Line Co.**

Project: Conversion of 99 miles of 6-in. from the Wichita Falls area to near Fort Worth, Tex., plus a 15-mile extension of the line to the Grapevine area northeast of Fort Worth.
Status: Conversion under way. Extension planned.

- **El Paso Natural Gas Co.**

Project: 11 miles of 4-in. L.P.G. products from Snyder Line to South Andrews Plant, Texas.
Status: Planned.
Project: 240 miles of 6-in. from Odessa to El Paso, Tex.
Status: Planned.
Contractor: **Pipeline Engineering Co.** has design and engineering contract. **Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contracts.
Completion: Early 1958.

- **Florida Pipeline & Storage Co.**

Project: 67-mile products line from Everglades, Fla., to Homestead Air Force Base, 25 miles south of Miami.
Status: To start in summer.
Contractor: **Fish Service Corp.**
Completion: December 1957.

- **Great Lakes Pipe Line Co.**

Project: 93 miles of 8-in. from south of St. Paul to Eau Claire, Wis.; 68 miles of 12-in. from Great Lakes intersecting point with Badger Pipe Line to Chicago.
Status: Under way.
Contractor: **R. H. Fulton & Co.** has the 8-in. **Midwestern Contractors, Inc.** has the 12-in.
Project: 15 miles of 6-in. from Lincoln, Neb., to Lincoln air base.
Project: 140 miles of 8-in. from Minneapolis to Superior terminals.
Project: 34 miles of 12-in. from Tulsa to Barnsdall, Okla., replacing 12, 8-in. lines.
Contractor: **Midwestern Constructors, Inc.**
Project: 14 miles of 8-in. from Coffeyville to Independence, Kans., replacing 4-in. line.
Contractor: **Jess Whitlow Pipe Line Service.**
Project: 11 miles of 8-in. from approximately 10 miles east of the Great Lakes pumping station at Donahue, Iowa, to terminals on the Mississippi River at Bettendorf, Iowa.
Contractor: **R. T. Perry Pipe Line Construction.**

- **Laurel Pipeline Co.** (Gulf Refining Co., Sinclair Pipe Line Co., and The Texas Co.)

Project: 100 miles of 24-in. and 340 miles of line graduating down to 14-in. at the west terminus, from Philadelphia refining area to Cleveland.
Status: To start early 1958.
Completion: 1958.

- **Northwest Pipeline Corp.** (an affiliate of Pacific Northwest)

Project: 80 miles of 8-in. and 300 miles of 10-in. products and crude line from Four Corners area to Salt Lake City.
Status: Proposed.

- **Odessa Butadiene Co.**

Project: 240 miles of 6-in. from Odessa to El Paso, Tex.
Status: Planned.
Completion: March 1, 1958.

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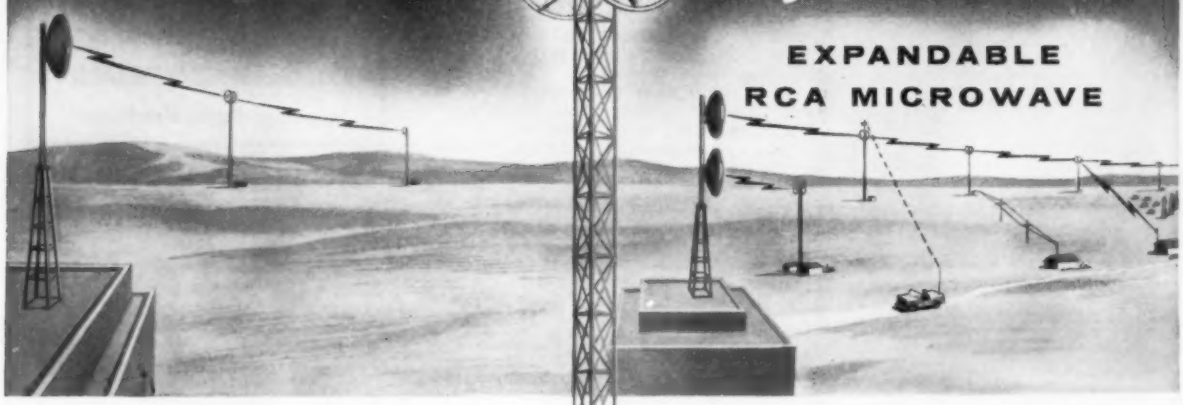

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Pipeline Patrol

- **Ohio Oil Co.**
  Project: 350-miles of 12-in. from Wood River, Ill., to Chicago.
  Status: Work to start fall 1957.
  Completion: 1958.
- **Salt Lake Pipe Line Co.**
  Project: 80 miles of 8-in. looping of line from Boise, Idaho, to Pasco Wash.
  Status: Pipe has been ordered.
  Completion: Late 1957.
- **Southern Pacific Pipe Lines, Inc.**
  Project: 100 miles of 10-in., 80 miles of 8-in., and 125 miles of 6-in. between Richmond, Calif., and Fallon, Nev.
  Status: Under way.
  Contractor: **River Construction Corp.** has 84 miles of 8, 10-in. from Richmond to Stockton, Calif., to complete July 15, 1957. **Hood Construction Co.** has 58 miles of 10-in. from Lodi to Roseville, Calif., to complete July 15, 1957, Bill Burgess, supt., office at Sacramento. **Engineers, Limited Pipeline Co.** and **Joe E. Young Pipe Line Construction Co.** have 180 miles of 6 and 8-in. between Rocklin, Calif., and Fallon, Nev.
  Completion: August 1, 1957
- **Trust Pipe Line Co.** (Cosden Petroleum)
  Project: 128 miles of 6-in. from Hawley, near Abilene, to Wichita Falls, Tex.
  Status: To start July 1957.
  Contractor: **Pipe Line Technologists, Inc.,** has the design and engineering.
  Completion: October 1957.
- **Underground Storage & Exploration, Inc.**
  Project: 393 miles of 12-in. L.P.G. line from Moundsville, W. Va., to Newark, N. J., plus 95 miles of 6, 8-in. laterals to Mauch Chunk, Pa., and to Philadelphia.
  Status: Proposed.
- **Union Oil Co. of California**
  Project: 815-mile line from Rifle, Colo., to Los Angeles refining area, to carry products from its Rifle shale-oil plant.
  Status: Proposed.

U.S. Natural-Gas Pipelines

- **American Louisiana Pipe Line Co.**
  Project: 7 miles of 16-in. and 5 miles of 12-in. at North Holly Beach Field and Second Bayou Field, Cameron Parish, La.
  Status: Has temporary FPC permit.
- **Arkansas Louisiana Gas Co.**
  Project: A 300-mile line, plus gathering lines, from Tex.-La. coastal area to northern La., to connect with present system.
  Status: Long-range plans.
- **Atlantic Seaboard Corp.**
  Project: 14 miles of 26-in. looping in Hardy and Randolph counties, West Virginia.
  Status: Has temporary FPC approval.
- **Carolina Pipeline Co.**
  Project: 177 miles of 2, 3, 4, 6, 8, and 10-in. between Blacksburg and Camden, S. C.
  Status: Under way.
  Contractor: **Panama-Williams Corp.** has construction contract. **Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contract.
- **Cascade Natural Gas Corp.**
  Project: 15-mile line to General Petroleum Corp.'s refinery at Ferndale, Wash., from Pacific Northwest Pipeline Corp.'s main line.
  Status: Under way.
  Completion: August 1, 1957.
- **Central Hudson Gas & Electric Corp.**
  Project: 46 miles of 10-in. from Albany to Kingston, N. Y.
  Status: Under way.
  Contractor: **Williams-Austin Construction Corp.,** O. L. Martin and Ralph Gaddy, of 4-in. field lines in Eureka Field, Okla.
  Status: Approved. Under way.
  Contractor: **Vaughn & Taylor Construction Co.**
  Project: 4 miles of 16-in. at Sarcoxie, Mo. spread superintendents, office at Catskill, N. Y.
  Completion: November 1, 1957.
- **Cities Service Gas Co.**
  Project: 8 miles of 16-in., 20 miles of 8-in., 20 miles of 6-in., and 20 miles of 4-in. field lines in Barber County, Kansas.
  Status: Approved. Under way.
  Contractor: **Vaughn & Taylor Construction Co.**
  Project: 3 miles of 12-in., 8 miles of 10-in., 4 miles of 8-in., 8 miles of 6-in., and 37 miles

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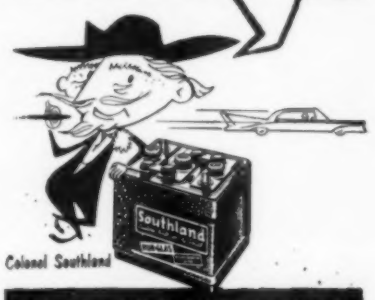

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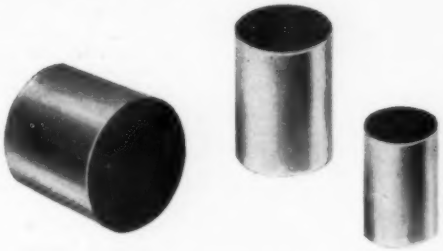

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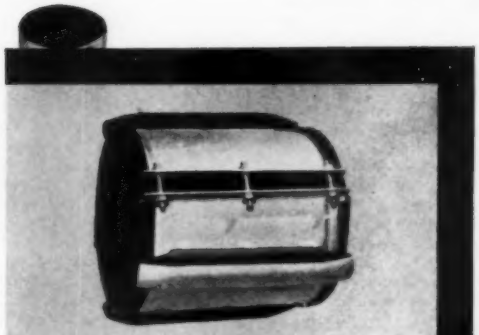

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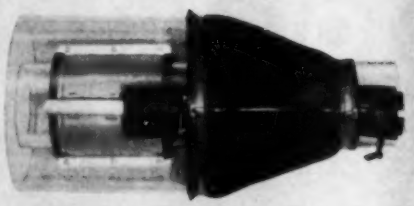

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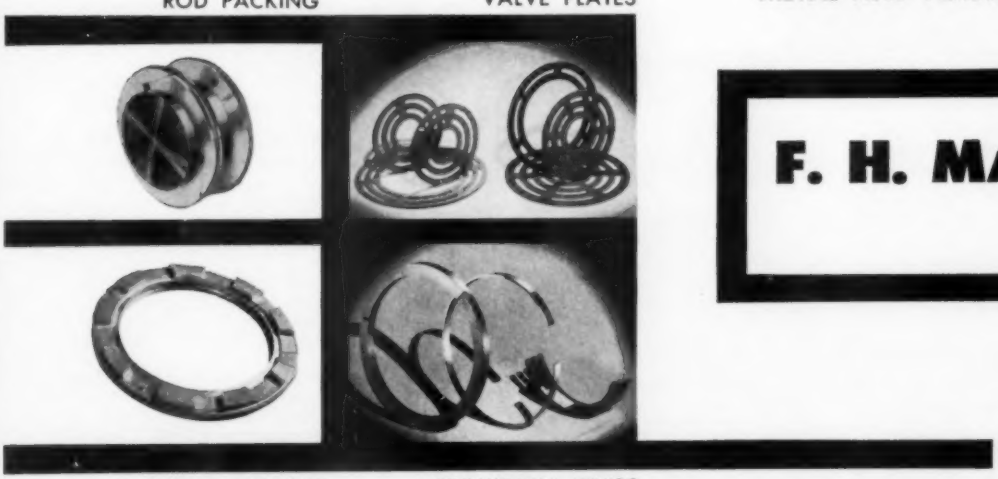

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Pipeline Patrol

Status: Approved. Under way.
Contractor: **Prairie Construction Co.**
Project. 64 miles of 6 to 30-in. in Leavenworth and Anderson counties, Kansas, Cass County, Missouri. and Oklahoma County, Oklahoma.
Status: Planned.
Project: 75 miles of 30-in. from Independence to near Welda, Kan.
Status: Pending FPC approval.

• **Coastal Transmission Corp.**
Project: 575 miles of 12, 20, 22, 24-in. main line and 414 miles of 2 to 14-in. gathering lines between McAllen, Tex., and Baton Rouge, La.
Status: Under way.
Completion: January 1, 1958.

• **Colonial Natural Gas Corp.**
Project: Two systems; one between Houston-Lake Charles area and Miami, Fla.; one in the Carolinas and Georgia.
Status: Proposed.

• **Colorado Interstate Gas Co.**
Project: 1957 program . . . 66 miles of 30-in., 40 miles of 34-in., 109 miles of 26-in., and 100 miles of 24-in. from Springfield, Colo., to Pueblo, Colo; 345 miles of 30-in. from Kit Carson, Colo., to Beatrice, Neb.; 50 miles of 22-in. from Laverne to Hooker, Okla.; 24 miles of 22-in. Panhandle field looping.
Status: Pending FPC approval. Has temporary approval for the 50-mile, 22-in. section in Oklahoma.

• **Eastern Shore Natural Gas Co.**
Project: 34 miles of 8-in. and 90 miles of 6-in. from connection with Transcontinental Gas Pipe Line Corp. in Maryland, across entire length of Delaware to Salisbury.
Status: Pending FPC approval.

• **East Ohio Gas Co.**
Project: 90 miles of 24-in., and 23 miles of 30-in. from Richfield to Summerfield, Ohio.
Contractor: **Sharman, Allen, Gay & Taylor, Inc.,** James Adams, spread superintendent, office at Wadsworth, Ohio. **Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contract.
Completion: November 1957.

• **El Paso Natural Gas Co.**
Project: 74 miles of 34-in. San Juan main line loops.
Status: Planned. Filed for FPC permit.
Completion: August 1957.
Project: 94 miles of 18-in. from Panoma Plant, Gray County, to Dumas Plant, Moore County, Texas.
Status: Under way.
Contractor: **R. H. Fulton & Co. Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contract.
Completion: July 1957.
Project: 177 miles of 20-in. from Sonora Plant, Sutton County, to Plains Plant, Yoakum County, Texas.
Status: Planned. Filed for FPC permit.
Completion: January 1958.
Project: 74 miles of 30-in. Permian-San Juan main line loops.
Status: Planned. Filed for FPC permit.
Completion: January 1958.
Project: 216 miles of 6 to 34-in. in Arizona, Texas, and New Mexico, plus 533 miles of various size line.
Status: Filed for FPC permit.
Project: 47 miles of 30-in. from proposed Lindrith, N. M., plant to proposed Chaco, N. M., plant.
Status: Under way.
Contractor: **Foutz & Bursum Construction Co.**
Completion: 1957.
Project: 38 miles of various size line to make additional gas available for processing at the McElroy-Wilshire gasoline plant (recently purchased from Lone Star Producing Co.) near Crane, Tex.

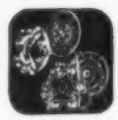
• **Houston Texas Gas & Oil Corp.**
Project: 702 miles of 24-in. from Baton Rouge, La., to Kissimmee, Fla.; 240 miles of 18-in. from Kissimmee to Cutler, Fla.; 642 miles of 3 to 18-in. sales laterals in Florida. Main line to join Coastal Transmission's proposed line from McAllen, Tex., to Baton Rouge.
Status: Under way.
Contractor: **Midwestern Constructors** has the 702 miles of 24-in.; **Harbert Construction Corp.** has remainder.
Completion: June 1958.

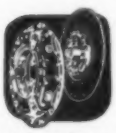
• **Illinois Power Co.**
Project: 6 miles of 6-in. line between Hoffman and Carlyle, Ill., plus distribution lines.
Status: Under way.
Contractor: **Mid-States Construction Co.,** H. A. Hane, spread superintendent, office at Carlyle, Ill.
Completion: September 1, 1957.

• **Intermountain Gas Co.**
Project: 16 miles of 6-in. from Payette to Weister, Ida.
Contractor: **Hood Construction Co.,** V. H. Bailey, supt., office at Payette.
Completion: September 15, 1957.
Project: 16 miles of 6-in. near Mountain Home, Ida.
Contractor: **Hood Construction Co.,** Sam Shearman, supt., office at Boise.
Completion: September 1, 1957.

• **Iron Ranges Natural Gas Co., St. Paul**
Project: 68-mile transmission line and 47 miles of laterals to supply towns on the Mesabi Iron Range, Minn.
Status: Application pending with FPC.

ROCKFORD
POWER TAKE-OFFS
PROJECT
LOW COST
DESIGN


Small Spring Loaded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Heavy Duty Over Center

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Speed Reducers

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Experience has taught pipeline construction people a few simple words—spoken daily in many languages—that have become the soundest basis for economical, efficient pipelining jobs the world over. If you're in the pipeline industry, you know the meaning of these words: "Be sure it's Crose equipment."

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Pipeline Patrol

• **Kansas-Nebraska Natural Gas Co.**
Project: 61 miles of various size gathering line in Camerick field, Texas County, Okla.
Status: Approved.

• **Manufacturers Light & Heat Co.**
Project: 50 miles of 10, 12-in. from Waynesburg to Pittsburgh, Pa.; 40 miles of 16-in. and 20 miles of 6 to 12-in. from Corning to Dundee, N. Y.
Status: 50-mile section under way; remainder to be started July 15, 1957.
Contractor: **Harford Brothers,** A. M. Harford and Robert Mann, superintendents.
Completion: 50-mile section to be completed July 15, 1957; remainder September 15, 1957.

• **Michigan Consolidated Gas Co.**
Project: 67 miles of 10 and 12-in. between Sears and Travers City, Mich.
Status: Under way.
Contractor: **Somerville Construction Co.;** Floyd Huduall, spread superintendent, office at Cadillac, Mich.
Project: 60 miles of 10 and 12-in. between Muskegon and Ludington, Mich.
Status: Under way.
Contractor: **Somerville Construction Co.,** jointly with **J. L. Gentry Construction;** Frank Morris, spread superintendent, office at Hart, Mich.

• **Michigan Wisconsin Pipe Line Co.**
Project: 24 miles of 24-in. and 18 miles of various size looping in Michigan, Indiana, Illinois, Wisconsin, Iowa, and Missouri.
Status: Approved.
Completion: October 1, 1957.

• **Midwestern Gas Transmission Co.**
Project: Will build main line from Portland, Tenn., to Canadian border near Emerson, Man.; 829 miles of 24-in., 109 miles of 16-in., 174 miles of 12-in., plus 648 miles of 3 to 18-in. extensions in Minn. and Wis.
Status: Application pending with FPC.

• **Mississippi River Fuel Corp.**
Project: 54 miles of 26-in. loops in La., Mo., Ark.
Status: Pending with FPC.

• **Montana-Dakota Utilities Co.**
Project: 28 miles of 12-in. from Fallon County to Dawson County, Montana.
Status: Approved.
Project: 6 miles of 12-in. between Mandan and Bismarck, N. D.
Status: Has temporary approval.

• **Mountain Fuel Supply Co., Salt Lake City**
Project: 38 miles of 20-in. to connect with Pacific Northwest Pipeline Corp.'s system in Sweetwater County, Wyoming.
Status: Approved.
Project: Extension of 12-in. line from Ogden to Logan and Brigham City, Utah.
Status: Has applied to Utah Public Service Commission.
Completion: Late 1957.

• **Natural Gas Pipeline Co. of America**
Project: 350 miles of 20 and 26-in. from Jack and Wise counties, Texas, to Fritch, Tex., plus a gathering system.
Status: Under way.
Contractor: **R. H. Fulton & Co.** has Red River crossing in northern Montague County. **Fulton & Brodie, Inc.,** Lubbock, Tex., has gathering system. **Eastern Pipeline Contractors,** Dallas, has 80 miles of 20-in. from Bridgeport, Tex., to Healdton, Okla. Remainder not let.
Completion: Total project to be completed by December 1, 1957.
Project: 389 miles of 36-in. loops along its line from Beatrice, Neb., to Chicago, to take gas from proposed line of Colorado Interstate Gas Co., and 91 miles of 30 in. loops along parts of its main line.
Status: Application pending with FPC.
Project: 337 miles of 30-in. between Fritch, Tex., and Beatrice, Neb., and 59 miles of 36-in. between Beatrice and Joilet, Ill., along Natural's existing system from the Texas Panhandle to Chicago.
Status: Pending FPC approval.
Completion: 1959.

• **New York State Natural Gas Corp.**
Project: 15 miles of 30-in. from Horseheads to Newfield, N. Y.; 31 miles of 20-in. from Harrison to Woodhull, N. Y.; 10 miles of 12-in. from Stockbridge to Oneida, N. Y.
Status: Planned.
Project: 12 miles of 12-in. near Oneida, N. Y.
Status: To start September 15, 1957.
Contractor: **Harford Brothers,** A. M. Harford and Robert Mann, superintendents.
Completion: October 15, 1957.

• **Niagara Mohawk Power Corp.**
Project: 14 miles of 18-in. from Phoenix to Palermo, N. Y.
Status: Planned.
Completion: October 1, 1957.
Project: 261 miles of 2 to 16-in. transmission and distribution mains to service areas in central, eastern and northern New York.
Status: Planned.
Contractor: Various.
Completion: December 31, 1957.

• **North Carolina Natural Gas Corp. (Subsidary of Colonial Natural Gas Corp.)**
Project: 630 miles of 2 to 16-in. from Transcontinental Gas Pipe Line Corp.'s system near Mooresville, eastwardly across north Carolina.
Status: To start fall 1957.
Completion: Spring 1958.

• **Northern Natural Gas Co.**
Project: 160 miles of 2, 3, 6, 8-in. branch lines to serve 20 new communities on Aberdeen, S. D., line.
Status: Under way.

This announcement is neither an offer to sell nor a solicitation of an offer to buy these securities. The offer is made only by the Prospectus.

Kerr-McGee Oil Industries, Inc.

$20,000,000

5¼% Sinking Fund Debentures, due June 1, 1977

With Common Stock Purchase Warrants Attached

Warrants entitle holders to purchase 5 shares of the Company's common stock for each $1,000 debenture at $80 per share from April 1, 1958 to June 30, 1964.

Price 100% and Accrued Interest

220,000 Shares
Common Stock

Price $70.75 per Share

Copies of the Prospectus may be obtained in any State only from such of the several Underwriters, including the undersigned, as may lawfully offer these securities in such State.

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Incorporated

June 25, 1957.

SPECIFICATIONS . . . Closing time: 0.1 second
Leakage: 0 Volume flow: over 40,000 s.c.f.m.
Inlet pressure: over 3,000 psig
Temp. range: +400° F. to −300° F.
Size: inlet dia. 2" — outlet dia. 8" — length 18"
Downstream pressure regulated up to 300 psig
Pressure regulation maintained within 1% of setting
Downstream pressure programmed with timing motor

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AiResearch Industrial Division

9225 South Aviation Blvd., Los Angeles 45, California

DESIGNERS AND MANUFACTURERS OF TURBOCHARGERS AND SPECIALIZED INDUSTRIAL PRODUCTS

Pipeline Patrol

Contractor: **Troth Construction Co.**

Project: 73 miles of 20-in. from Savana Creek to Pincher Creek fields in Alberta, Canada; 32 miles of 24-in. from Pincher Creek to Montana border; 1,100 miles of 26-in. from Montana into Minneapolis.

Status: Planned.

Project: 365 miles of main line and 1,090 miles of branch lines to serve communities in Minnesota, Iowa, South Dakota, Nebraska, and Wisconsin.

Status: Filed with FPC March 18, 1957.

Project: 13 miles of 16-in. to replace existing 10-in. line in Hansford County, Texas.

Status: Has temporary FPC authority.

- **Offshore Gathering Corp.,** Houston.

Project: 364 miles in Gulf of Mexico off Louisiana: 60 miles of 24-in., 70 miles of 26-in., 234 miles of 30-in. (Dual line.)

Status: Application pending with FPC.

- **Ohio Fuel Gas Co.**

Project: 11 miles of 18-in. and 11 miles of 20-in. from Gibsonburg, Ohio to Toledo; and 30 miles of 24-in. looping from Pavonia to Attica, Ohio.

Status: Pending FPC approval.

Project: 152 miles of line in Ohio: 43 miles of 24-in. from Crawford Station to Utica; 18 miles of 24-in. from Pavonia Station to Line D; 6 miles of 20-in. from Mount Gilead to Claridon; 4 miles of 20-in. near Dayton; 4 miles of 20-in. near South Charleston; 7 miles of 16-in. near Springfield; 6 miles of 20-in. nnear Oberlin; 17 miles of 20-in. from Oak Hill to Symmes Station; 7 miles of 12-in. from Mount Sterling to Bloomingburg; 2 miles of 8-in. near Bellefontaine; 3 miles of 12-in. near Mansfield; 4 miles of 12-in. near Lakeville; 7 miles of 8-in. in Guernsey and Belmont counties.

Status: Under way.

Contractor: **O. R. Burden Construction Corp.** has the 43 miles of 24-in. from Sugar Grove near Crawford station, to Utica, Ohio, and 27 miles of 20-in. south from Wellston.

Completion: Second half 1957.

- **Pacific Gas & Electric Co.**

Project: 138 miles of 34-in. looping of the Topock-Milpitas line.

Status: Under way.

Contractor: **Engineers Limited Pipeline Co.**

Completion: December 1, 1957.

Project: 5 miles of 16-in., 160 miles of 12-in., 8 miles of 6-in. from Corning to Eureka, Calif.

Status: Planned.

Contractor: **Engineers Limited Pipeline Co.** and **Alex Robertson Co.**

Completion: January 1958.

Project: 13 miles of 12-in., 2 miles of 10-in., from Santa Cruz to Davenport, Calif.

Status: Planned.

Completion: October 1957.

- **Pacific Northwest Pipeline Corp.**

Project: 37 miles of 6-in. from Dove Creek to Nucla, Colo., and 13 miles of 4-in. from Nucla to Urvan, Colo.

Status: Has FPC permit.

Project: 1,000 miles of gathering lines and laterals along present line.

Status: Planned.

Completion: 1957.

Project: 35 miles of 4, 6-in. laterals from its 26-in. Shonohomish County, Wash., line to Grotto, Wash.; 5 miles of 3-in. lateral from its Urvan, Colo., lateral to Slick Rock, Colo.; 41 miles of 6-in. from its Coeur d'Alene lateral to near Kellogg, Idaho.

Status: Filed with FPC May 29, 1957.

- **Pennsylvania Gas Co.**

Project: 23 miles of 10-in. in Erie County, Pa., 15 miles of 8-in. in Warren and Chautauqua counties, Pennsylvania, 30 miles of branch lines and a number of small distribution systems.

Status: Has FPC permit.

- **Peoples Natural Gas Co.**

Project: 58 miles of 2 to 14-in. extension and replacement lines in Pennsylvania.

Status: Under way.

Completion: September 1957.

- **Permian Basin Pipeline Co.**

Project: 83 miles of 16-in. from its Spraberry station in Midland County, Texas, to tie in with Pioneer Gathering System, Inc., at a point in northwestern Schleicher County, Texas.

Status: Has temporary FPC approval.

- **Phillips Petroleum Co.**

Project: 3 miles of 24-in. in Moore County, Texas.

Status: Planned.

Completion: October 1, 1957.

Project: 30 miles of 3 to 8-in. in Moore, Hutchinson, Sherman, Hansford, and Gray counties, Texas, and in Texas County, Oklahoma.

Status: Planned.

Contractor: Various.

Completion: January 1, 1958.

- **Piedmont Gas Co.,** Hickory, N. C. (Parent is Carolina Natural Gas Corp.)

Project: 78 miles of 2 to 8-in. extension off Trancontinental in North Carolina to serve Gaston, Lincoln, Catawba, Caldwell, and Burke counties.

Status: Has FPC approval.

- **Pioneer Gathering System, Inc.**

Project: 70 miles of mostly 16 and 12-in. in Val Verde, Schleicher and Sutton counties, Texas.

Status: Under way.

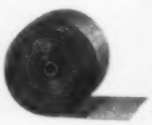
Competion: Early fall 1957.

- **Signal Oil & Gas Co.**

Project: 80 miles of gathering lines to

J-M Asbestos and Tar Felt

C-R-C Glass Wrap


C-R-C Outer Wrap

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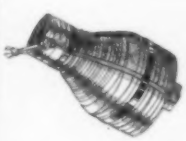
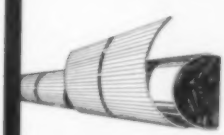

Casing Seals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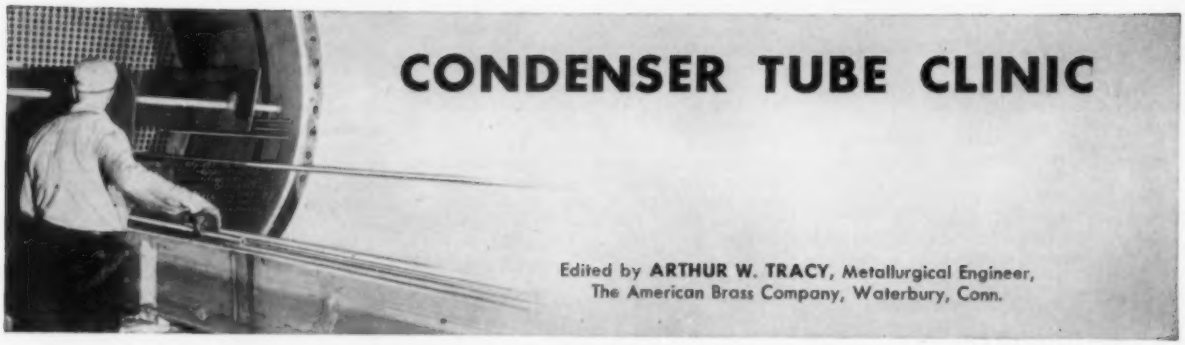

CONDENSER TUBE CLINIC

Edited by **ARTHUR W. TRACY**, Metallurgical Engineer,
The American Brass Company, Waterbury, Conn.

Some operating factors that affect tube life

COMPOSITION OF THE COOLING WATER

The quantities of cooling water used in condensers preclude any treatment to make the water less corrosive, except where the water is recirculated. Economics often does not permit locating a power plant at a site where water is not corrosive.

In general, however, plants located inland will have relatively noncorrosive cooling water. Plants situated on tidewater will have corrosion problems, especially if the water is polluted with industrial or domestic sewage and conditions are such that organic matter in the sewage can ferment under anaerobic conditions, with the consequent formation of sulfides. Water in an enclosed harbor or dead-end channel, where the water is more or less stagnant, is particularly subject to infestation by anaerobic bacteria.

PREVENTIVE MAINTENANCE

Frequent cleaning of tubes to remove slimes containing bacteria and the simultaneous removal of sulfide scales will increase tube life. Chlorination of polluted water at frequent intervals, or periodically filling the water spaces in the condenser with chlorine gas, will not only remove the slimes but may also aid in breaking down the unwanted sulfide films which have formed on the inner walls of the tubes.

In some cases, it may be possible to dredge the channel bottom near the water intake to remove accumulations of decaying vegetable matter.

An American Brass Company Chemist uses Photo-Electric Colorimeter to analyze cooling water samples as a basis for tube alloy selection.

MEDIA BEING COOLED OR CONDENSED

It is not usually possible to change the corrosive properties of products being handled in the process industries. The venting of noncondensable gases, however, will markedly increase tube life. This is particularly true on the steam side of boiler feed-water heaters and other steam-heated equipment where accumulations of oxygen, carbon dioxide, and ammonia can cause rapid failure of condenser tubes.

TEMPERATURE

The corrosion rate of metals usually increases with increasing temperature. This is a problem particularly in refinery condensers where water velocities are often relatively low and the water temperature is relatively high. At low water velocities, the formation of gas bubbles on the water side of a tube can initiate pitting which may continue even after the bubble has disappeared. In such cases, a judicious increase in water velocity will insure longer tube life, provided the velocity is not increased to a point where impingement corrosion can occur.

Many believe that condenser tubes put in service in the winter when water is cool will last longer than those started in the summer. A more protective film of corrosion products forms on the tube wall in winter, probably because the water is freer of sulfides.

TECHNICAL HELP IN SELECTING TUBES

Your situation may require special consideration and analysis. We are always ready to help and advise in the selection of the right alloy to give best service. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 57B6

ANACONDA®

Tubes and Plates for
Condensers and Heat Exchangers
Made by
The American Brass Company

PHYSICAL PROPERTIES OF ANACONDA CONDENSER TUBES*

ALLOY	Tensile Strength, psi	Yield Strength at .5% Elongation Under Load, psi	Elongation in 2", %	Rockwell Hardness, B Scale	Density, Lb. per Cu. In.	Thermal Conductivity, B.T.U./Sq. Ft./In./Hr./°F. at 68° F.	Average Coefficient of Linear Thermal Expansion per °F. (77-572 F.)
Arsenical Admiralty-439	52,000	22,000	60	6-45	0.308	768	.0000112
Ambraloy-927	60,000	27,000	55	35-65	0.301	696	.0000108
Ambraloy-901	60,000	30,000	60	30-60	0.295	552	.0000099
Cupro Nickel, 30%-702	55,000	22,000	50	30-60	0.323	204	.0000090
Cupro-Nickel, 10%-755							
Light Annealed	44,000	22,000	46	25	0.323	314	.0000093
Light Drawn	60,000	57,000	15	68			
Red Brass-24	42,000	15,000	50	0-30	0.316	1104	.0000104
Ambronze-421	46,000	20,000	55	0-30	0.316	830	.0000102
Phosphorized Arsenical Copper-108							
Light Drawn	40,000	35,000	20	20-50	0.323	1344	.0000098
Hard Drawn	54,000	50,000	8	50-70			
Phosphorized Copper-103							
Light Drawn	40,000	35,000	20	20-50	0.323	2364	.0000098
Hard Drawn	54,000	50,000	8	50-70			

*Note: The above values are approximate and should not be used for specification purposes. *Light annealed except as noted.*

Pipeline Patrol

Tioga, N. D., gasoline plant from South Blue Buttes, Antelope, and North Blue Buttes, McKenzie County, N. D.
Status: Under way.
Contractor: **C. F. Bartley & Son**, Tioga, N. D.
Completion: October 1, 1957.

• **Southern California Edison Co.**
Project: 200-mile line from San Joaquin Valley gas fields to power plant at Redondo Beach, Calif.
Status: Under way.
Completion: 1957.

• **Southern California Gas Co. and Southern Counties Gas Co. of California.**
Project: 4 miles of 30-in. from Los Angeles River to Victoria Station at Los Angeles.
Status: Planned.
Completion: July 30, 1957.

• **Southern Natural Gas Co.**
Project: 10 miles of 8-in. laterals in Napoleonville Field and Fort Jackson Field, La.
Status: Has FPC approval.
Completion: December 1, 1957.
Project: 32 miles of 6-in. from Chandeleur Sound area, Breton Island, La.; 7 miles of 8-in. and 5 miles of 10-in. from Main Pass area to Olga, La.; 9 miles of 8-in. from Bastian Bay Field to Fort Jackson Field; 7 miles of 8-in. laterals in Manila Village Field.
Status: Plan to apply for FPC permit.
Completion: December 1, 1957.

• **Spokane Natural Gas Co.**
Project: 400 miles of 1 through 24-in. distribution system at Spokane.
Status: Under way.
Contractor: **Hallmac Construction Co.**; V. L. Williams, spread superintendent, office at Spokane.
Completion: 1957.

• **Tennessee Gas Transmission Co.**
Project: 221 miles of 30-in., 101 miles of 26-in., and 10 miles of 24-in. looping from Portland, Tenn., to Greenup, Ky.; from Morehead, Ky., to Catlettsburg, Ky.; from Catlettsburg to Broad Run, W. Va.; from New Wilmington, Pa., to Mercer, Pa.; and from New Castle, Pa., to near Pittsburgh, Pa.
Status: Pending FPC approval.
Contractor: **Bechtel Corp.** has 24 miles of 30-in. from Olive Hill to Greenup, Ky., to complete August 3, 1957, M. A. (Slim) Roberts, supt., office at Grayson, Ky. **Oklahoma Pipe Line Constructors** has 35 miles of 30-in. in Ky., Gene Gohring, supt., office at Richmond.
Project: 51 miles of 26-in., 51 miles of 20-in., and 17 miles of 12-in. gathering lines from Kinder, La., to offshore fields in Gulf of Mexico.
Status: Has temporary FPC approval.
Project: 577 miles of 30-in. from Mississippi River delta area south of New Orleans to Portland, Tenn.
Status: Pending FPC approval.
Project: 76 miles of 24-in. between Coudersport, Pa., and Hamburg, N. Y.
Status: Pending FPC approval.
Project: 33 miles of 6, 8, 10-in. laterals in Southwest Pass area below New Orleans.
Contractor: **Houston Contracting Co.** H. E. Murphy, supt., office at Venice.

• **Texas Eastern Transmission Corp.**
Project: 17 miles of 8-in. and 3 miles of 6-in. from its 20-in. Baytown-Hankamer line to Alco-Mag field in Harris County, Texas.
Status: Has FPC approval.
Project: 97 miles of 30-in. loops between Kosciusko, Miss., and Uniontown, Pa., and 40 miles of 10-in. laterals.
Status: Has FPC approval.
Completion: September 1, 1957.
Project: 667 miles of 30-in. from Kosciusko, Miss., to Uniontown, Pa.
Status: Under way.
Contractor: **H. C. Price Co.** (64 miles from Barton, Ala., to Mount Pleasant, Tenn.; 51 miles from Mount Pleasant to Gladeville, Tenn.; 52 miles from Gladeville to Tompkinsville, Ky.; 68 miles from Tompkinsville to Danville, Ky.; 63 miles from Danville to Owingsville; 46 miles from Owingsville to Wheelersburg, Ohio. Will use four spreads); **Williams Brothers Co.** (63 miles from Egypt, Miss., to Barton, Ala.; 64 miles from Berne, Ohio, to Uniontown, Pa.); **Houston Contracting Co.** (80 miles from Kosciusko to Egypt, Miss.; 57 miles from Wheelersburg to Athens, Ohio, W. H. Hayes, supt., office at Oak Hill; 61 miles from Athens to Berne, Ohio, R. E. Thornton, supt., office at Caldwell).
Completion: Fall 1957.

• **Texas Illinois Natural Gas Pipeline Co.**
Project: 10 miles of 36-in. to loop existing single 30-in. near Joliet, Ill.
Status: Has FPC approval.

• **Transcontinental Gas Pipe Line Corp.**
Project: 172 miles of 36-in., 68 miles of 30-in., 162 miles of 24-in., and 64 miles of smaller diameter pipe to loop main line from Texas to New Jersey.
Status: Work in North Carolina under way.
Contractor: **Western Construction Co.** has 65 miles of 36-in. and 45 miles of 30-in. at scattered spots along system in S. C., N. C., Pa., and Va. Work will start in N. C., office at Winston-Salem.
Completion: December 1957.
Project: 110 miles of 36-in., 16 miles of 30-in., and 13 miles of 24-in. looping in S. Car., Ga., Ala., Miss., and La.
Status: Under way.
Contractor: **Sharman, Allen, Gay & Taylor, Inc.**, E. D. Singleton, superintendent.

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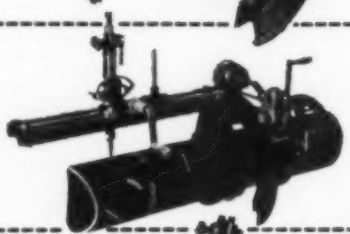

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Pipeline Patrol

Completion: November 1957.
Project: 29 miles of 16-in. lateral off the coast of Cameron Parish, La., and extending to company's existing system near Lake Charles.
Status: Approved. Under way.
Contractor: **Sharman Allen, Gay & Taylor, Inc.,** J. B. Robbins, superintendent, office at Orange, Tex.
Completion: July 15, 1957.
Project: 57 miles of main line in La., Miss., Ala., Ga., S. C., and 247 miles of laterals in Tex. and La.
Status: Has temporary FPC approval.

- **United Gas Pipe Line Co.**

Project: 40 miles of 8-in. from Baldwin County, Alabama, to Container Corp.'s plant.
Status: Has FPC permit.

Canadian Crude-Oil Pipelines

- **Act Oils, Ltd.** (subsidiary of Canada Southern Petroleums, Ltd.)

Project: A 450-mile line from the Peace River region of northern B. C. to tidewater at Bella Coola, B. C.
Status: Request has been made for permit from the B. C. government.

- **B-A Alberta Pipe Line, Ltd.**

Project: 35 miles of 8-in. to connect Drumheller field, Alberta, with existing lines running to Edmonton.
Status: Pending approval.

- **Interprovincial Pipe Line Co.**

Project: 156 miles of 20-in. to extend present line from Sarnia to Port Credit, Ont.
Status: Under way.
Contractor: **Robert Somerville Co., Ltd.** and **Sheehan Constructors of Canada, Ltd.** have 90 miles from Sarnia to Bright, Ont., Jim Brown, superintendent, office at Strathroy.
Completion: September 1, 1957.
Project: 33 miles of 24-in. from Kendal to Peebles, Sask.
Status: Under way.
Contractor: **Fulton Banister, Ltd.,** John O'Rourke, superintendent, office at Wolseley, Sask.
Completion: July 31, 1957.
Project: 79 miles of 26-in. from Clearbrook Minn., to Superior, Wis.
Status: Under way.
Contractor: **R. H. Fulton & Co.**
Completion: August 31, 1957.

- **Pembina Pipe Line, Ltd.**

Project: 100 miles of 3 to 12-in. gathering line in Pembina oil field, Alta.
Contractor: **Universal Pipe Line, Ltd.,** subsidiary of Mannix, Ltd., T. Childress, spread superintendent, office at Drayton Valley, Alta.
Completion: November 1, 1957.

- **Royalite Oil Co., Ltd.**

Project: 250-mile line from Athabasca oil sands, northeastern Alta., to Edmonton.
Status: Long range plans.
Completion: 1960.

- **Trans Mountain Oil Pipe Line Co.**

Project: 100 miles of 30-in. loops: 50 miles east of Kamloops, B. C., and 50 miles west of Edson, Alta.
Status: Under way.
Contractor: **R. A. Conyes Construction Co.** has the 50 miles east of Kamloops; **Dutton-Williams Brothers, Ltd.** has other 50.
Completion: July 31, 1957.

- **Westspur Pipe Line Co.**

Project: 20 miles of 12-in. from Alida in southeastern Saskatchewan, to the Carnduff-Glen Ewen area to tap Cantal, Hastings Florence, Carnduff, and Glen-Ewen fields 34 miles of 4, 6, 8-in. gathering lines.
Status: Has requested permit from Board of Transport Commissioners.
Contractor: **Majestic Contractors, Ltd.,** Jeff Minter, spread superintendent, office at Estevan, Sask.
Completion: No date set.
Project: 75 miles of 16-in. from Steelman Sask., to Cramer, Man., Canada.
Status: Under way.
Contractor: **Gragg (Canada), Ltd.**
Completion: July 30, 1957.

Canadian Products Pipelines

- **Hydrocarbons Pipeline Co.** (Subsidiary of Canadian Hydrocarbons).

Project: 800 miles of 6 and 8-in. L.P.G. line from near Edmonton, Alta., to Fort William, Ont.
Status: Has permit from Parliament of Canada. If approved by Federal Board of Transport Commissioners and the Alberta Petroleum and Natural Gas Conservation Board, work will start in 1957.
Construction consultants: **Dutton-Williams Brothers, Ltd.,** Calgary, and **A. D. Little & Co.,** Boston.

Canadian Natural-Gas Pipelines

- **Alberta Gas Trunk Line Co., Ltd.**

Project: 637 miles of 34 to 16-in. gathering lines in Alberta.
Status: Under way.
Contractor: **Dutton-Williams Brothers, Ltd.** has preliminary studies, design and management-engineering. **Universal Pipe Line, Ltd.** subsidiary of Mannix, Ltd., jointly with **Marine Pipeline & Dredging Co.,** has crossing of Red Deer River near Cavendish, Alta., J. Hysuick, spread superintendent, office at Empress. **Fulton Banister, Ltd.,** has 17 miles of 34-in. west from Trans-Canada pipeline origin near Burstall, Sask., to near Cavendish, Alta., and 100 miles of 18-in. north to Bindloss and Provost fields, John O'Rourke and George

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Pipeline Patrol

Caron, superintendents, office at Empress, Alta., to complete summer 1957.

Completion: River crossing completed. Total project to be completed in 1960.

• **Inland Natural Gas Co., Ltd.**

Project: 304 miles of mainline and 25 miles of laterals from Savona to Nelson, B. C.: 150 miles of 12-in.; 112 miles of 10-in., 67 miles of 6-in. Also will build 400 miles of distribution piping in 31 towns.

Status: Under way.

Contractor: **Dutton-Williams Brothers, Ltd.** Pat Campbell, project manager, office at Penticton.

Completion: October 1, 1957.

• **Northern Ontario Pipe Line Crown Corp.** (formed by the federal and Ontario governments).

Project: 675 miles of 30-in. from the Ontario-Manitoba border to near Kapuskasing, Ont. (part of the 2,250-mile Trans-Canada line. Upon completion this section will be leased to Trans-Canada Pipe Line Co. with option to buy.)

Status: 79-mile section from Stedman to Forham Township under way.

Contractor: **Dutton Williams Brothers** has 58 miles from the Manitoba-Ontario border west of Kenora to a point east of the crossing of Ontario Highway 17. **Morrison Shivers, Ltd.** has 94 miles from the east crossing of Highway 17 to a line separating the townships of Hyndman and Hodgson. **Majestic Contractors & Associates** has 80 miles from the Morrison Shivers terminal to Stedman Township. **Houston Contracting Co.** has 79 miles from Stedman to Forham Township, R. L. Silar, spread superintendent, office at Raith, Ont. Remainder not let.

Completion: End 1957.

• **Plains-Western Gas & Electric.**

Project: 25 miles of 10-in. from the Trans-Canada Pipe Line to Brandon, Manitoba.

Status: Under way.

Contractor: **Banister Construction, Ltd.** Ole Johnson, superintendent.

Completion: September 1, 1957.

• **Saskatchewan Power Corp.**

Project: 13 miles of 4-in. lateral to town of Kerrobert, and 10 miles of 6-in. lateral to Kindersley Power Plant, Sask.

Status: Planned.

Contractor: **Banister Construction, Ltd.**

Completion: **July 15, 1957.**

Project: 300 miles of 1 to 20-in. distribution lines at Regina, Sask.

Status: Planned.

Contractor: **S. E. Construction (Alberta) Ltd.,** and **Pacific Pipeline Construction (Alberta), Ltd.,** jointly.

• **Trans-Canada Pipe Lines, Ltd.**

Project: 574 miles of 34-in. from the Alberta-Saskatchewan border to Winnipeg, 310 miles of 20-in. from Toronto to Montreal, 33 miles of 24-in. from Toronto to Niagara, N. Y. (First part of 2,250-mile line from Alberta to Toronto and Montreal. One 675-mile section is being built by Northern Ontario Pipeline Crown Corp.)

Status: Under way.

Contractor: **Majestic Contractors, Ltd.** (104 miles from Burstall to Stewart Valley, Sask., R. L. Leonard, supt., office at Cabri); **Canadian Bechtel, Ltd.** (110 miles from Swift Current to Moose Jaw, Sask., completed, and 87 miles from Portage la Prairie to Winnipeg, Man., to complete August 20, 1957, J. L. (Joe) Work, supt., offices at Portage la Prairie and Winnipeg); **Universal Pipe Line, Ltd.,** subsidiary of Mannix, Ltd. (90 miles from Moose Jaw to Welseley, Sask., supt., Otis Hare, office at Regina, Sask.); **Dutton-Williams Brothers, Ltd.** (97 miles from Deveren to Moosomin, Sask., to complete August 1957, plus 120 miles of 20-in. between Toronto and Montreal); **Price-Poole of Canada, Ltd.** (100 miles from near McGregor to Miniota, Man.); **Oklahoma Pipe Line Constructors** (83 miles of 20, 24-in. between Toronto and Montreal, and between Toronto and Niagara, N. Y.); **Grayco Constructors, Inc.** (120 miles of 20-in. between Toronto and Montreal).

Completion: September 1957.

Project: 82 miles of 30-in. from near Winnipeg to the Ontario-Manitoba border.

Status: Under way.

Contractor: **Majestic Contractors, Ltd.,** K. B. Killingsworth, spread superintendent, office at Ste. Anne, Man.

Completion: October 15, 1957.

• **Union Gas Co. of Canada, Ltd.**

Project: 142 miles of 26-in. from Dawn Township to Hamilton, Ontario, plus 55 miles of 6 to 20-in. laterals, and 317 miles of 2 to 12-in. distribution lines.

Status: Planned.

Contractor: **Bechtel Corp.** has the 26-in. line, to complete November 10, 1957, office at Galt, Ont.

Completion: November 30, 1957.

Project: 17 miles of 8 to 20-in. storage lines in Dawn Township, Ontario.

Status: Planned.

Completion: August 1957.

• **Westcoast Transmission Co., Ltd.**

Project: 650 miles of 30-in. from Peace River area, Alta., to Sumas, Wash., plus gathering lines.

Status: Under way.

Contractor: **Dutton-Williams Brothers, Ltd.** (120 miles from Taylor B. C. to Azouzetta Lake, completed); **Universal Pipe Lines,**

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Ltd., subsidiary of Mannix, Ltd. (110 miles between Huntingdon and Kingsvalle, B. C., F. L. Byers, supt., office at Hope, B. C.); **Canadian Bechtel, Ltd.** (210 miles from Alexandria to Pine Pass, B. C., H. F. (Hank) Mogg, general supt., office at Prince George, B. C.); **R. A. Conyes Construction Co.** (210 miles); **River Construction Corp., Ltd.** (142 miles of 12, 18, 20, 26-in. gathering lines in northern Alta and B. C., E. L. (Tex) Maggard, supt., office at Dawson Creek, B. C.); **Marine Pipeline & Dredging, Ltd.** (Fraser and Peace River crossings, Waldo Trim, supt., offices at Fort Saint John and Hope, B. C.).

Completion: Dutton-Williams and Marine Pipeline work completed. R. A. Conyes to finish work Seuptember 1957. Universal Pipe Lines and River Construction Corp. to complete work September 1, 1957. Bechtel to finish August 20, 1957.

Project: 174 miles of 30-in. from Savanna Creek area, Alta., to Canadian-Idaho border.

Status: Proposed.

Foreign Crude-Oil Pipelines

- **Aramco-I.P.C.-Iranian Consortium.**

Project: 1,500 miles of 38 or 40-in. line from Persian Gulf to Mediterranean at Iskenderun, Turkey.

Status: Proposed.

- **Bolivian Gulf Oil Corp.**

Project: 160 miles of 10-in. and 43 miles of 8-in. from Sicascia to Arica on the Chilean coast.

Status: Awaiting pipe.

Contractor: Williams Brothers Co.

Completion: December 1957

- **Burmah Oil Co., Ltd.**

Project: 850 miles of 20-in. from Nahorkatiya to Calcutta, India.

Status: Proposed.

- **Caltex**

Project: 30 miles of 30-in. from Duri field in Sumatra to Dumai where a deepwater terminal will be built. Line will be extended 35 miles to Minas field later.

Status: Planned.

Completion: Duri-Dumai line to be finished in 1959; extension to Minas later.

- **Colombian Petroleum Co.**

Project: 42 miles of 6-in. from Tibu field to Rio de Oro in Colombia.

Status: Under way.

- **C.R.E.P.S., Societe Nationale de Recherche et d'Exploitation des Petroles en Algerie (SN Repal), and Cie. Francaise des Petroles Algerie**

Project: Two 10-in. lines from Hassi Messaoud and Edjele, Algeria to the railhead at Touggourt.

Status: Planned.

Completion: 1958.

Project: 450 miles of 16-in. from Edjele field in southeastern Algeria to a Mediterranean port on the Libyan coast.

Status: Pipe has been ordered.

- **Creole Petroleum Corp.**

Project: 87 miles of 30-in. from Temblador field to Caripito in Venezuela.

Status: To start work early 1958.

Contractor: **Pipe Line Engineering Co.** jointly with **Oklahoma Pipe Line Constructors.**

Completion: April 1958.

Project: 9 miles of 26-in. from Ule to La Salina in Venezuela.

Status: Planned.

Completion: Late 1957.

- **Deutsche-Shell A.G.**

Project: 120 miles of 20, 24-in. from Marseilles, France, to Rotterdam, Germany, to tap the proposed 700 mile trans-Europe line being considered by the Royal Dutch-Shell Group.

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2. The high molecular weight oriented type of plastic used in NERVATAPE insures uniform longitudinal and transverse tensile and tear strength.
3. Adhesive and backing never separate when tape is twisted or stretched.

SPECIFICATIONS

Type of backing	Polyethylene Black
Thickness in Mils	13
Tensile Strength lbs./in.	25
Elongation % at Break	100
Adhesion oz./in. minimum	35
Insulation Resistance Megohms	1,000,000
Dielectric Strength Volts	15,000
Electrolytic Corrosion Factor	1.0
Operating Temperature	−30°F. to 200°F.

ROLLS: 100 ft. long: Widths: 1" and multiples of 1"

CHEMICAL PROPERTIES: Excellent resistance to acids, alkalies, oils, corrosive salts, salt and fresh water. Not affected by sunlight.

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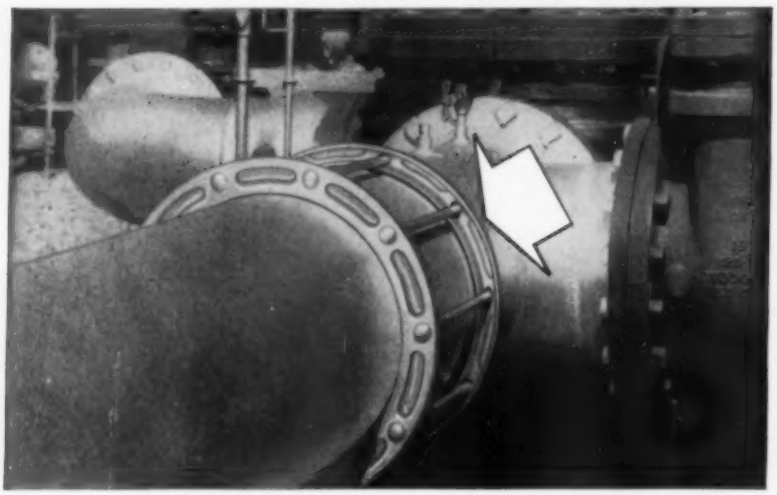

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Pipeline Patrol

Status: Planned.
Completion: 1960.

- **Iraq Petroleum Co.**

Project: About 600 miles of up to 40-in. from Kirkuk field through Iraq and Turkey to the Turkish port of Iskenderun on the Mediterranean sea.
Status: Proposed. Survey completed.

- **Mene Grande Oil Co.**

Project: 97 miles of 30-in. from fields in Eastern Venezuela to Puerto La Cruz.
Status: Under way.
Contractor: **Fulghum Contracting Corp.** has 22 miles between Oficina and Anaco.
Completion: First quarter 1958.

- **National Iranian Oil Co.**

Project: A 1,000-mile line to move Qum crude to the Mediterranean.
Status: Under study.

- **North-West Oil Pipelines Co.** (newly formed by six West German refiners, headed by affiliates of Standard Oil Co. (N.J.), and British Petroleum Co., Ltd.)

Project: 210-mile line from the refining enters in the industrial Ruhr area of West Germany to Wilhelmshaven.
Status: Planned.
Completion: 1959.

- **Royal Dutch-Shell**

Project: 700-mile line across Europe from the Mediterranean to the North Sea, running through Eastern France, Luxembourg, West Germany, and Netherlands, and Belgium. Main trunk to be 30-in.
Status: Company is considering project together with several other companies.

- **Sinclair Oil Corp. and Socony Mobil Oil Co.**

Project: 211 miles of 20-in. from the Silvestre field in Barinas, Venezuela, to Puerto Cabello on Caribbean Sea.
Status: Under way.
Contractor: **Williams Brothers Sudamericano, Ltd.**
Completion: July 1957.

- **Standard-Vacuum Petroleum Maatschappij.**

Project: 94 miles of 8-in. from Lirik field, Central Sumatra, to deep-water terminal on Siak River, near Buatan. A 3-in. hot-water "defroster" line will be laid under the 8-in. to heat the heavy crude.
Status: Under way.
Completion: Late 1957.

- **Ste. Nationale de Recherche et d'Exploitation des Petroles en Algerie**

Project: Line in Sahara Desert area to move oil from Hassi Massaoud field. Two routes possible: 200 miles from the field northwest to Laghouat; 260 miles from the field to the north and slightly east to Biskra.
Status: Under study.
Status: Under way.

- **Union of Soviet Socialist Republic**

Project: 2,300-mile Trans-Siberian crude and products line from Ufa and the Tuimaza fields in Bashkiria to Irkutsk near Lake Baikal.

- **Yacimientos Petroliferos Fiscales** (Argentina)

Project: 932 miles of 12-in. from Campo Duran to San Lorenzo.
Status: Under way.
Contractor: **TECHINT** (Compania Tecnica Internacional), Buenos Aires, has 90 miles.

Foreign Products Pipelines

- **Empresa Nacional de Petroleos** (Government of Chile) and **Cia. de Petroleos de Chile (Copec), et al.**

Project: 75 miles of 10-in. from Chile's coastal refinery at Concon to Santiago.
Status: To start work September 1957.
Contractor: **Williams Brothers**
Completion: Early 1958.

(Continued on page 213)

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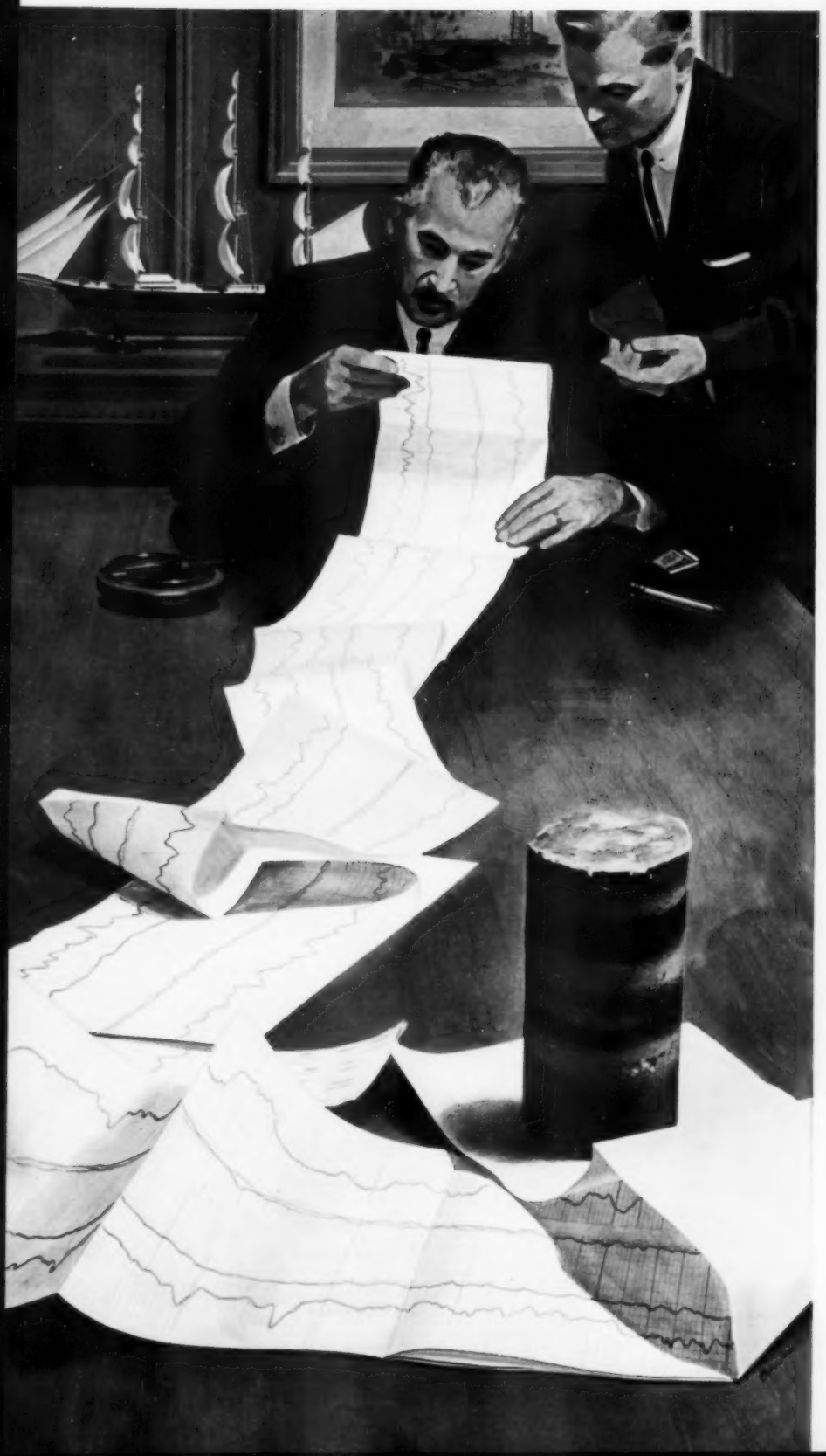

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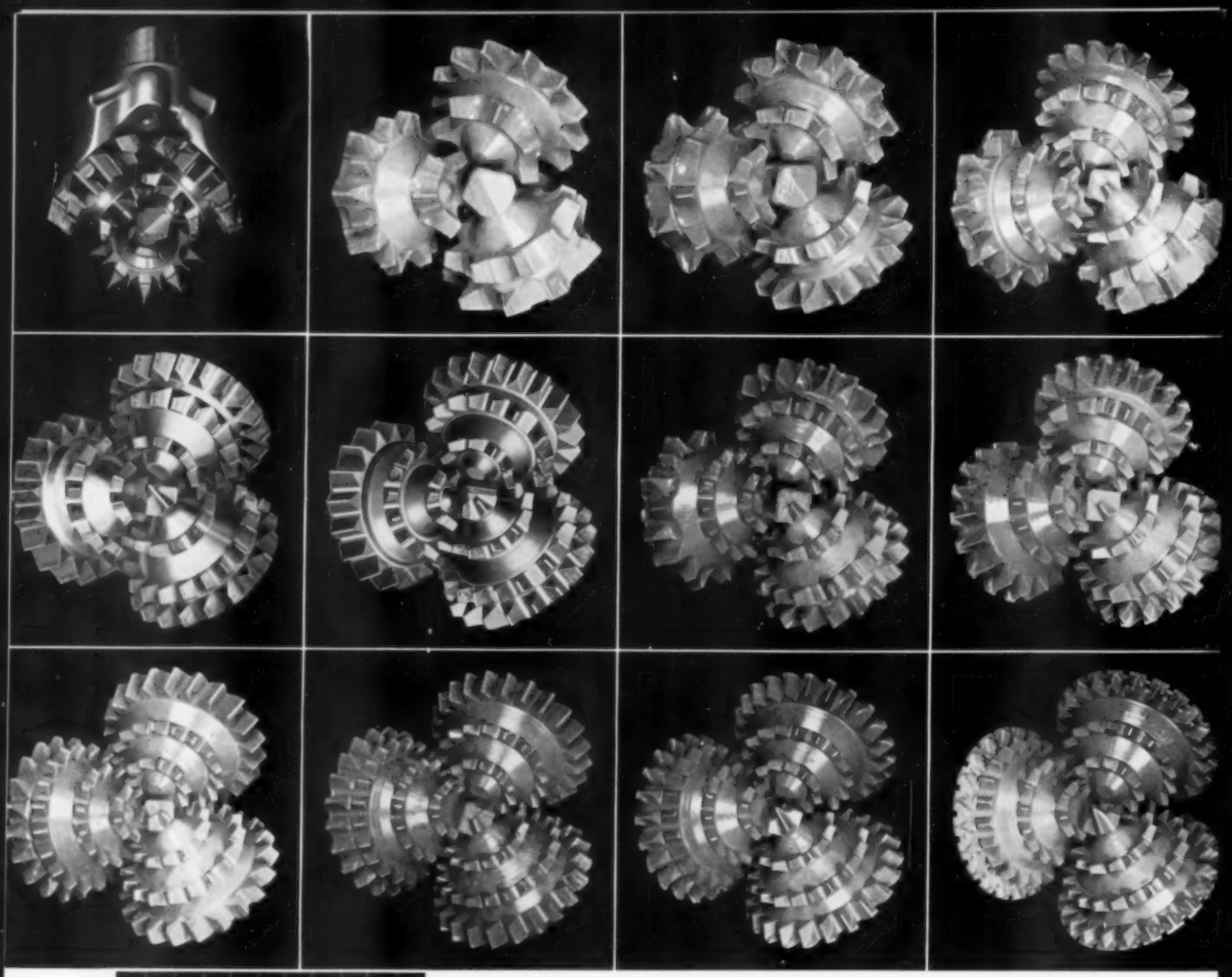

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Penrod's New Deep-Water Drilling Barge Ready To Go to Work in Gulf off Louisiana's Coast

PENROD DRILLING CO., Shreveport, soon will place in operation in the Gulf of Mexico off the Louisiana coast a newly completed self-stabilizing submersible drilling barge capable of drilling in water depths to 75 ft. It is scheduled to drill under contract for California Co.

The barge, the Jim Woodruff Barge No. 48, is 190 ft. long and 150 ft. wide. It has a 12-ft. hull with a 37-ft. by 32-ft. slot. Height, from keel to underside of the lower deck, is 90 ft.

Drilling equipment is centered around a Continental-Emsco Edes draw works. The rig is diesel-electric powered. It includes a P4-27½-in. rotary table and two National G-1000 mud pumps, and uses a Lee C. Moore four-position derrick with a lifting rating of 1,000,000 lb.

Main power plant consists of 5 Caterpillar D-397 diesel engines, each driving a GE 500-hp. d.c. generator with 2 a.c. motor-driven 40-kw. d.c. exciters. Auxiliary power and lighting are supplied by 3 Caterpillar D-397 diesel engines driving 300-kw., 3-phase, 60-cycle, 480-volt a.c. generators and attached exciters.

Crew quarters, offices, dining salon, and recreation room are air-conditioned. Three Meco vapor-compression distillation units are capable of providing 21,600 gal. of fresh potable and drilling water daily.

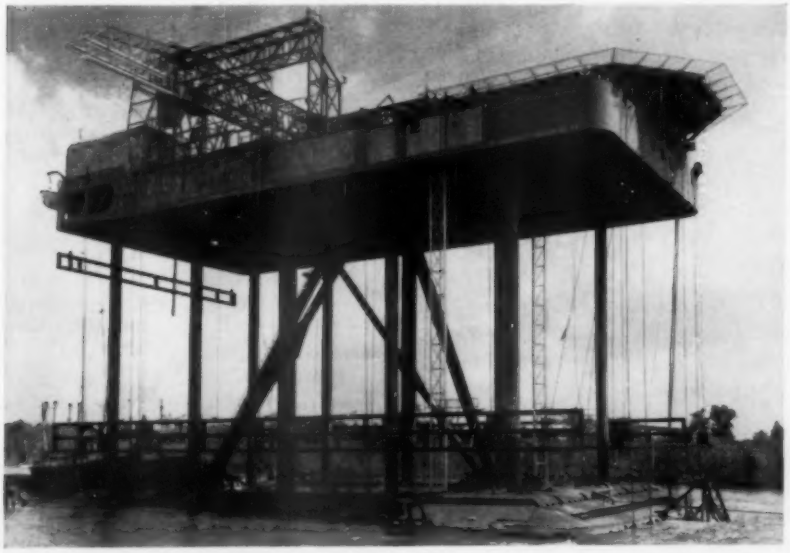
The barge was built by Bethlehem Steel Co.'s shipbuilding division at its Beaumont, Tex., yard. Design was by Friede & Goldman, Inc., naval architects and marine engineers, of New Orleans.

Dixilyn Names Brigham To High Executive Post

Election of H. S. Brigham, formerly Gulf Oil Corp.'s zone manager of production at Laurel, Miss., as executive vice president of Dixilyn Drilling Corp., Odessa, Tex., has been announced by M. O. Boring, Jr., president.

Brigham for the time being will continue to maintain his residence at Laurel, an operational center for southern Mississippi and Alabama, where Dixilyn has been active as a contractor for Gulf and other companies.

He had been with Gulf companies for more than 14 years, starting as a field superintendent in California, his native state, for Western Gulf Oil Co. in 1943. Prior to his transfer to Laurel,



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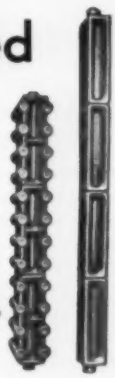

INFERNO Reflex and Transparent Gages can be furnished in any length. One-piece bodies milled from solid bar stock. 1" thick glass . . . no spot pressure on glass. Write for Bulletin No. 33.

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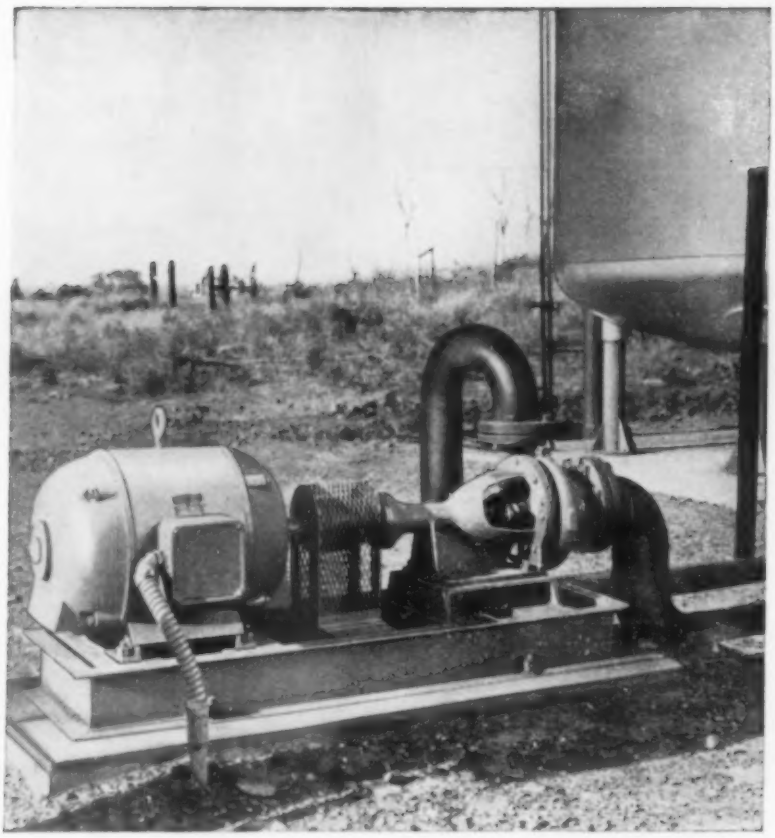

A Centrifugal Pump Salt Water Can't Damage!

Ampco Pumps are ideal for salt-water disposal and flooding operations:

- *Transfer service*
- *Pumping over aerators*
- *Pumping through filters*
- *Back-flushing filters*
- *Delivery of treated water*

It's an AMPCO . . . made from aluminum bronze that contains no zinc.

Ampco Pumps resist corrosion, erosion, abrasion, cavitation-pitting, and dezincification. They are made from Ampco alloys engineered specifically to resist salt water corrosion.

Durability isn't the only advantage of Ampco Pumps. They have high efficiency . . . up to 85%. You pay considerably less for power.

Ampco Pumps are available in more than 100 different combinations, with speeds from 1750 to 3500 rpm; capacities to 600 gpm; heads to 300 feet.

Contact us in Milwaukee for the name of your nearest AMPCO PUMP DISTRIBUTOR.

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Dept. OGJ-7, Milwaukee 46, Wis. • West Coast Plant: Burbank, Calif.

THE METAL WITHOUT AN EQUAL

P-23

he was Western Gulf's division manager of production in California.

Dixilyn has been expanding its contracting operations. It now has land rigs working in various parts of Texas, Mississippi, and Alabama, and offshore rigs off the Louisiana coast in the Gulf of Mexico. In addition it expects delivery in November of a mobile drilling platform that can operate in water up to 105 ft. in depth.

Field Drilling Co. has contract for a 5,500-ft. wildcat in Jim Wells County, South Texas. The well is C. C. Winn 1 Eva & Guy Seale, 8 miles north of Alice in La Tinaja de Lara Grant.

Graham-Michealis Drilling Co. has contract for 1 Whartman, a Humphrey Oil Co. wildcat in Stanton County, southwestern Kansas. The 5,700-ft. Mississippian try is 4 miles northwest of Johnson, Kansas, and 6 miles west of the west edge of Hugoton gas field. Location is C NW 2-28-41.

L & H Drilling Co. has contract for a 3,500-ft. well in Bayou Choctaw, in Iberville Parish, South Louisiana, for T. M. Hoffman. The 2 Wilbert Myrtle Grove will be drilled in 52-9s-11e.

Taylor Drilling Co. has contract for a Shell Oil Co. wildcat in Campbell County, Wyoming. The 14-18 H. W. Edwards is a 7,200-ft. Parkman test in the Powder River basin's northern portion in C SW SW 18-49n-75w.

J. D. Spencer has contract for a wildcat in Weston County, Wyoming, for **Brinkerhoff Drilling Co.** The 1 Government-A, SW SW 14-47n-68w, is rigging up rotary tools.

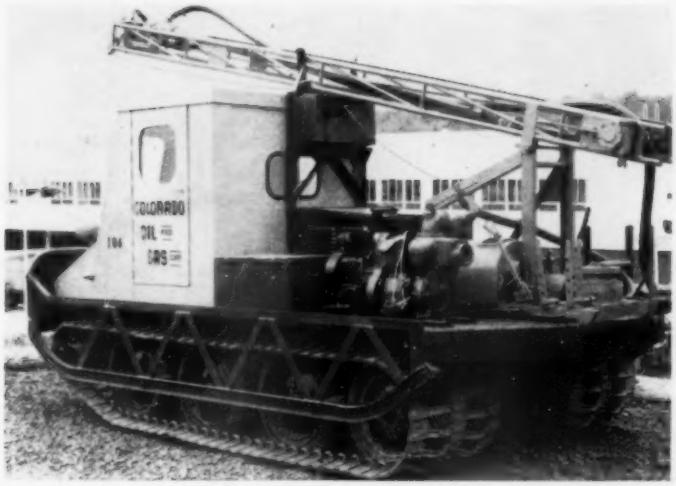
Exeter Drilling Co. spudded in at a wildcat for Plains Exploration Co. in Washington County, Colorado. The Denver basin wildcat is the 1 Turcheck, C SE SE 1-4n-49w, and will go to the Dakota "J" sand at 3,985 ft.

Penrod Drilling Co. has contract for a 10,000-ft. wildcat in Calcasieu Parish, South Louisiana, for H. L. Hunt. The 5 Lutcher-Moore Lumber Co. will go down in 14-7s-11w.

Wilrich Drilling Co., Ltd., was awarded drilling contract for a well in the Chard area of northeastern Alberta on Arab Oil farmout rights for Merrill Petroleums, Ltd. The wildcat is a granite wash test to 2,700 ft. Location is on LSD 5, 34-78-6w4. The 5-34 Chard is 155 miles northeast of Edmonton and 8¾ miles west of the Saskatchewan-Alberta border.

SHOWCASE...

NEW EQUIPMENT

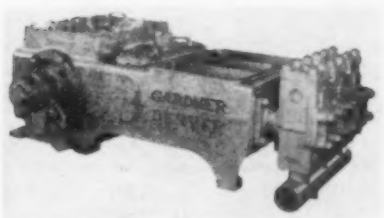


Muskeg Tractor Designed for Any Terrain

This muskeg tractor is designed to travel the bogs, marshy creeks, and ridges crisscrossing Alaskan terrain. A rubber track belt and pneumatic-tire-suspension system gives instant traction on any land surface, the maker reports. It properly distributes weight for low ground pressure.

The machine, controlled by steering bands, is powered by a Chrysler 115-hp. industrial engine. A two-thirds-width cab allows drilling pipe to be carried along the right side of the unit.

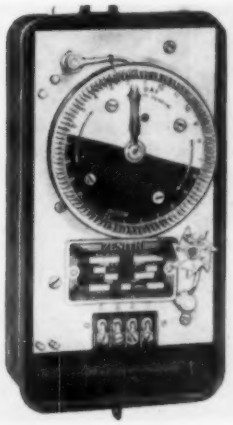
The drill with its specially constructed 10-ft. mast has a capacity of 150 ft. **Write or call: Symington of Seattle, 4535 Union Bay Place, Seattle 1, Wash., for details on Muskeg tractor.**



Oil-Well Servicing Pump Carries 6,000 Psi. Rating

Here is a new heavy-duty oil-well servicing pump with a maximum rating of 6,000 psi. on intermittent service. Called the PE-5, the triplex plunger pump's maximum ratings on intermittent service are stated as 130 b.hp., 290 r.p.m., 1,336 g.p.m., and 6,000 psi. Weighing 2,990 lb., the pump has a one-piece cast-steel fluid end, individually accessible valves, an eccentric drive, and one-piece connecting rods.

Although designed for oil-well servicing, this pump carries a continuous rating of 75 b.hp., making it suitable, according to the maker, for water flooding, salt-water disposal, and other continuous-operating services. **Write or call: Gardner-Denver Co., South Front Street, Quincy, Ill., for details on PE-5 pump.**



24-Hour Time Switch Controls Equipment

Completely automatic control of intermittently operated equipment of all types is provided by this 24-hour time switch, according to company officials. The switch will handle as many as 48 "on" and 48 "off" operations in one

Send this **Showcase Coupon**

to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in bold-face type at end of description.

NAME AND/OR MODEL NUMBER.....

.....

.....

Described in OIL AND GAS JOURNAL - Issue of July 8, 1957

NAME.....TITLE.....

COMPANY.....

ADDRESS.....

CITY.....STATE.....

DATE.....

New Equipment

day. Typical operations on which it can be used include oil wells, heating and air-conditioning equipment, stockers, and oil and gas burners.

A control dial, scaled in 15-minute graduations, is used to set up a daily operating schedule. Running periods are set by sliding self-contained, nonremovable trip levers in or out on the dial. The switch will repeat the entire schedule automatically each day.

A calendar cutout device which will make the switch completely selective for all 7 days of the week is available as an accessory.

The mechanism is powered by a synchronous industrial motor. The meter's capacity is rated at 1,000 watts, using 60-cycle a.c. power. The switch's action is single pole, double throw. **Write or call: Zenith Electric Co., Dept. OET, 152 West Walton Street, Chicago 10, Ill., for details on 24-hour time switch.**

●

Rotary Flanged Pump Handles 225 G.P.M.

With this new 6-in. Granco rotary positive-displacement flanged pump, it is possible to handle up to 225 g.p.m. of hot asphalts and up to 350 g.p.m. of gasolines and fuel oils, the maker reports.

Called the Model HG, the pump can be powered by a gasoline engine or other power source. It is available in steel or cast-iron construction.

The steel models, for hot asphalts and other viscous products, will operate at temperatures to 600° F. The cast-iron models are for gasoline and other lighter products. Both models operate at pressures up to 70 psi. **Write or call: Granberg Corp., 1308 Sixty-seventh Street, Oakland 8, Calif., for details on 6-in. p.d. pumps.**

Pneumatic Pump Handles Sludge or Slurry

This self-priming Pneuma pump lifts any liquid by displacing it with compressed air. It has no moving parts to become choked, and handles oil, chemicals, or water. According to the maker, it can be valuable for many applications, including the removal of silt and sand from ditches and pumping a sand and water mixture under pressure. Besides these, the pump has the ability to pump sludges and fluids carrying gases.

The pump unit has a compressor, motor, and distributor mounted on a base and connected to the pump body by metal, rubber, or plastic piping. The motivating agent, compressed air or pressurized gas, does not mix with the liquid.

The compressor-distributor unit may be placed at any level and within reasonable distance from the pumping area, or it can be made portable. Thus, in places where inflammable liquids have to be pumped, all moving parts such as the motor, etc., can be placed outside the danger zone and harnessed with any type of connection. **Write or call: Pneuma Pump of America, Ltd., 10040, 100th Street, Edmonton, Alta., Canada, for details on pneumatic pump.**

●

Coating and Primer Prevent Corrosion

Atmospheric corrosion problems on offshore drilling equipment involving high maintenance costs and shutdowns by reason of salt air and other corrosive elements may, in large measure, be offset with this polyvynol coating and primer, according to the maker.

The coating is said to provide safety assurance against the usual Gulf Coast salt-air and water-corrosion attacks, providing savings through preservation of equipment, and reduction of replacement and maintenance costs and shutdown time. **Write or call: Maintenance Engineering Corp., 3711 Clinton Drive, Houston 10, Tex., for details on polyvynol coating and primer.**

●

New Oscilloscope Checks Ignition Securely

Here is a new oscilloscope type of testing unit, known as the Sun Scope Model SS, for ignition analysis. The manufacturer claims the unit is easy to operate, even by personnel who have had no previous experience with an oscilloscope.

Pattern interpretation has been simplified and several features have been incorporated which make the unit suited for ignition-system testing.

According to the manufacturer, the Model SS always produces a full, unmodified waveform pattern on the screen due to the circuitry which determines the arrangement and trace. Waveform is continuous with no splitting or carryover. Cylinder-performance comparison is made possible by displaying all cylinder patterns across

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Unlike other metals sometimes used for cathodic protection, zinc anodes have an expected life of a minimum of fifteen years. Zinc anodes are self-regulating and require no current regulating resistors to meet the load demand, whether high or low.

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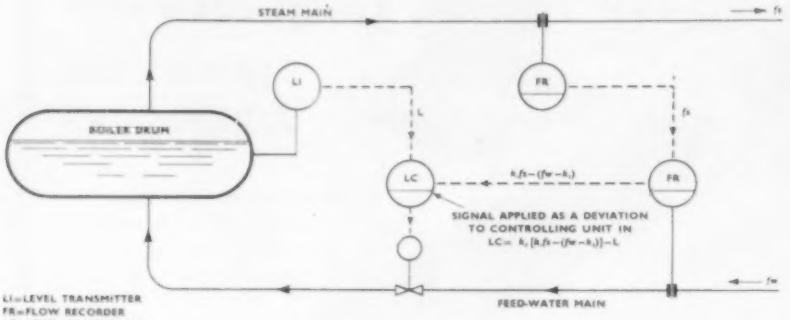
New Equipment

the screen, individually or in normal firing order.

Operating on 115-volt a.c. power, the testing device measures only 15 in. high, 10 in. wide, and 18 in. long. It weighs 35 lb. An elevating foot is provided to give better screen visibility when the scope is operated on a bench or portable stand. **Write or call: Sun Electric Corp., Harlem and Avondale, Chicago 31, Ill., for details on Model SS Sun Scope.**



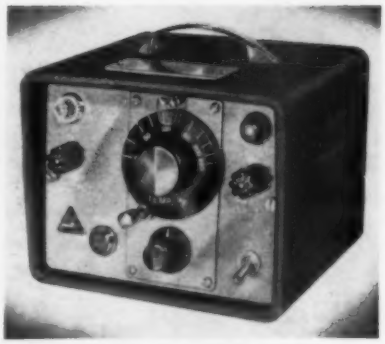
LI=LEVEL TRANSMITTER
FR=FLOW RECORDER
LC=LEVEL CONTROLLER
L=LEVEL
fs=STEAM FLOW
fw=FEED-WATER FLOW
k_1=CONSTANT SET FOR REQUIRED LEVEL CHANGE WITH LOAD
k_2=CONSTANT SET TO ALLOW FOR BLOW-DOWN
k_3=CONSTANT SET FOR REQUIRED COMPROMISE BETWEEN FLOW-RATIO CONTROL AND LEVEL CONTROL

Boiler-Level Control Adjusts Easily

The three-element drum-water-level-control system shown can form an integral part of any automatic-boiler-control scheme for water-tube boilers, according to the maker. The three elements refer to the three measurements: (1) feed-water flow, (2) steam flow, and (3) drum water level.

The system can be adjusted readily on the site to match the particular operating characteristics of the boiler plant. It makes use of four instruments: a drum-level transmitter, a steam-flow transmitter, a feed-water-flow instrument fitted with a computing and transmitting mechanism, and a level controller.

With the system installed, it is possible to set: (1) the amount by which the level changes with a given change of load, (2) the balance between flow-ratio control and level control, and (3) the value of a constant which is introduced into the water-flow signal to allow for blowdown. **Write or call: George Kent, Ltd., Luton, Bedfordshire, England, for details on three-element boiler-level control.**



Temperature Controller Allows Range Change

Easy change from standard to special temperature ranges, or conversion to control functions such as pressure, displacement, or acceleration is provided by this new Model 6365 process controller, the maker reports.

The controller, as delivered standard equipment, offers temperature control through the range of 0° to 250° F. but alternate temperature ranges can be obtained. A nominal control sensitivity of 1° F. in the standard temperature range makes the unit suitable for use in critical chemical processes. **Write or call: Autron Engineering, Inc., 1254 West Sixth Street, Los Angeles 17, Calif., for details on Model 6365 controller.**

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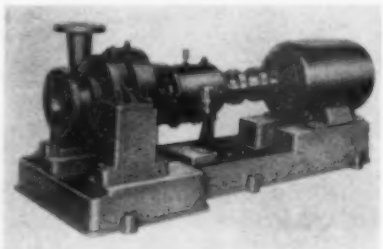

Centrifugal Pump Designed For Heavy-Duty Service

Here is a new vertically split centrifugal pump designed especially for heavy-duty service in petrochemical and petroleum plants. Constructed with centerline supported casings and circular casing joints with confined gaskets, the HN pump is suited for temperatures up to 850° F., the maker reports.

The pump is available in three models: (1) Type HN, end suction, top discharge, (2) Type HNT, top suction, top discharge, and (3) Type HNC, integral seal. Standardized parts provide maximum interchangeability and permit a low field parts inventory. **Write or call: Worthington Corp., Harrison, N. J., for details on Type HN pumps.**

Send this **Showcase Coupon**

to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in bold-face type at end of description.

NAME AND/OR MODEL NUMBER.....

.....

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SULFUR DIOXIDE
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Tennessee's Liquid Sulfur Dioxide, a product of highest purity, is particularly suitable as a solvent for recovery of aromatics—It is completely miscible with aromatic hydrocarbons over a wide temperature range, while the solubility of naphthene and paraffin hydrocarbons is limited and increases with decreasing temperature. Recovery of a higher percentage of aromatics is obtained for hydrocarbons over a wide boiling range.

Perhaps Tennessee's highest purity Liquid Sulfur Dioxide can effect a more efficient and economical operation in your processing. We would like to discuss these possibilities with you.

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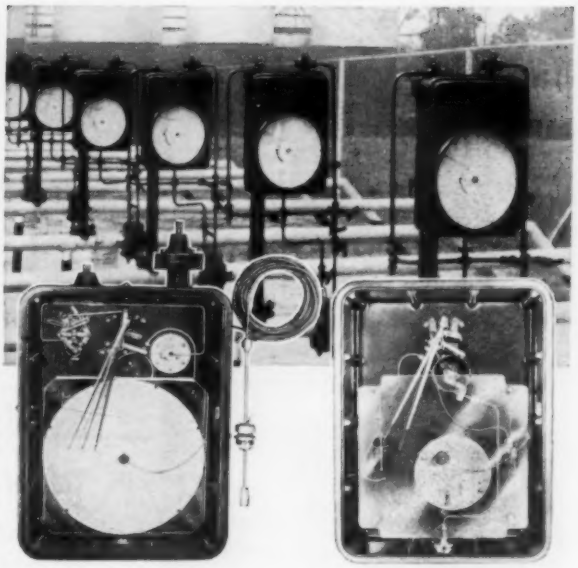
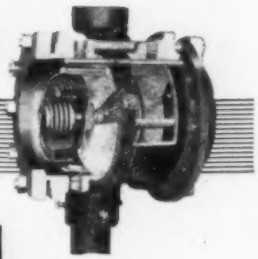


AMERICAN-WESTCOTT Series A-88 recording orifice meters for flow, pressure and temperature measurement—working pressures to 5000 psi—10, 20, 50, 100 and 200-inch ranges.

CANNON METER PENS for recording meters, available if desired, provide clear, legible chart records—hold up to a year's supply of ink.

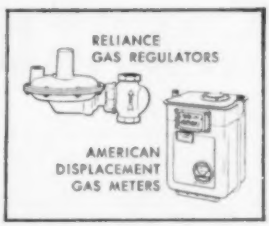
AMERICAN® DRI-FLO mercuryless orifice meters for working pressures to 5000 psi—20, 50, 100 and 200-inch ranges.



PRECISION MEASUREMENT

of flow, temperature, and pressure on one chart

Wherever precision measurement and economy of operation are required; at high or low flow rates, at varying temperatures, whether in recording, indicating, integrating or telemetering models, American orifice meters are synonymous with accurate, dependable, trouble-free service and low maintenance costs.



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Now Manufactured In Two Models For LP Gas and Natural Gas. 0-1000 psi for LP Gas Vapor and Natural Gas. Model also available in 0-3000 psi. ASTM 11-42-53

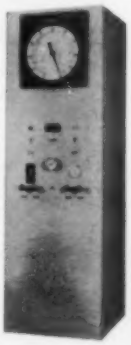
PRECISION DETERMINATIONS: Bureau of mines tests show that with manipulation dew points can be duplicated to within 0.2° F.
ACCURACY: Averaging test measurements, the Bureau of Mines reported less than 0.2°F. Dew point temperature difference compared to known standards.
SAFETY: Hydrostatic tests show a maximum working pressure of 3,000 psi. Adjustable mirror allows for safe visual observation into the pressure body.

DEW POINT RECORDER

BUREAU OF MINES TYPE

RECORDS DEW POINT OF GASES UNDER PRESSURE

SUITABILITY: For use with gases under pressure; at pressures from atmospheric to 3,000 psi.
CONTINUOUS RECORD: of dew point gas.
RAPID RESPONSE: To changing dew point of gas.
RELIABLE RESULTS: Obtained to allow for the control of dew point of natural gas in long distance high-pressure transmission lines. This instrument records dew point of a continuous sample of natural gas at line pressure up to 3,000 psi.



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Shur-Kure is packed in all-weather bags, easy to handle, mix and store. Shur-Kure is low cost, high allowance concentrations —no adverse effects to mud, no harm to product by action of pumps, guns, jet bits, etc.

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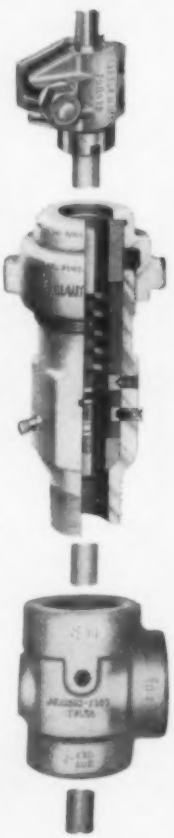
PART 3 A series on problems of stuffing box packing.

J-F...Perfect Pumping Package

BASIC CONSIDERATIONS

1. **Packing**
2. **Rod**
3. **ALIGNMENT**



Some phases of the alignment problem are the responsibility of the manufacturer, and some, of the producer. To assure alignment of the components manufactured by Johnson-Fagg, the following is exercised:

To assure straight and concentric threads in the Tee, J-F Pumping Tees are machined on an automatic indexing machine, indexing 90° for each threaded opening. All holes are bored with the proper taper before threading. Each Pumping Tee is gaged with both API thread gages and concentricity gages to assure perfect threads as well as perfectly aligned threads. This prevents the mis-alignment of stuffing box and Pumping Tee as related to the polished rod which, in turn, prevents egg-shaping of packing and shortening of packing life.

With the J-F Stuffing Box, equal care is taken in the top and bottom threading to insure proper alignment with the Tee as well as proper alignment with the center machined portion of the stuffing box.

The problem of proper alignment of the pumping unit over the well is the responsibility of the producer.

Bulletins PRL-257, SB-256 and T-255 present this information in more detail. They are available on request.

JOHNSON-FAGG, INC.

54th & Garnett Road Phone Riverside 2-3337
P. O. Box 7157 Tulsa, Oklahoma
Oil Field Pumping Specialists

SHOWCASE . . .

New Literature

Thermowell Bulletin. New Bulletin D covers T-E industrial thermowells for protecting temperature-sensing elements against mechanical injury and corrosive or contaminating atmospheres. The bulletin contains complete description of various types of thermowells, both bar stock and builtup, and the alloys in which they are available. Users can choose from over 5,700 different combinations to meet conditions of temperature, environment, and installation. Specifications for individual types are listed in chart form with corresponding ordering instructions. **Write or call: Thermo Electric Co., Inc., Saddle Brook, N. J., for Bulletin D.**

•

Gage Illuminator. Data Unit 300 illustrates and describes the new Jerguson liquid-level-gage illuminator which is said to give three times the illumination previously possible. The explosion-proof illuminator, of the solid-wedge-lighting type, gives an evenly diffused illumination from a single medium-base 58-watt bulb. And it is approved by Underwriters' Laboratories. It has a simplified relamping procedure whereby a turn of a thumb screw allows removing the cover and glass housing in one piece. **Write or call: Jerguson Gage & Valve Co., 80 Adams Street, Burlington, Mass., for Data Unit 300.**

•

Diesel-Powered Crawler Tractor is described in new foldout, Specification Sheet MS-1192. The sheet features a cutaway view of the tractor, showing both gear-type and hydraulic torque-converter-drive transmissions and many of the mechanical, design, and construction highlights of the tractor. The torque-converter drive is also reviewed along with its use advantages. **Write or call: Allis-Chalmers Mfg. Co., Milwaukee, Wis., for Specification Sheet MS-1192.**

•

Molded Mineral-Wool Pipe Insulation. Complete specifications for Mono-Kover, a slit one-piece sectional type of molded mineral wool pipe insulation that snaps into place, are presented in this new three-color bulletin. Besides describing insulating properties of the material, the pamphlet explains and illustrates approved application methods. Thermal conductivity is shown graphically for every temperature throughout the operating range (to 350° F.). The bulletin lists and describes the various facings for the ma-

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York, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, Portland, Ore., San Francisco, Bridgeport, Conn.

"According to Hoil"

H₂OIL GAS® GARD

FOR USE ON • PUMPING UNITS • TREATERS • DRILLING RIGS • COMPRESSORS • BUILDINGS

The H₂Oil Gas Gard is a safety device carefully designed and engineered to assure 100% protection against the numerous hazards involved where wet gas installations prevail. Its diversified applications make this unit a "MUST" where safety and economy are the prime objectives. Positive shut-off. 4" x 30" 125#—$54.50, F.O.B. Tulsa, Okla. Available in any size and pressure.

U. S. Pat. 2,710,666 Canadian Pat. 523,467

H₂OIL "GAGE IT"

- NO BATTERIES
- ACCURATE MEASUREMENT
- EASY TO READ
- SIMPLE TO OPERATE
- NOTHING TO WEAR OUT
- A NECESSITY FOR ALL PERSONS WHO MEASURE OIL
- ADAPTABLE TO ANY GAGE LINE

The H₂Oil "Gage-it" retails for $42.50. Approximate Packaged Weight Two Lbs. Standard Length Gage Tapes Available on Request.

The "Gage-it" is a device for determining the Water-Oil interface in a stock tank when attached to any standard type gauge line. It will also determine the Water-B.S. interface provided the B.S. carries enough water that a current may be established from the shell of the tank to the gauge plumb bob.

H₂OIL ENGINEERING CORP.

1601 South Yale TULSA 16, OKLA. P. O. Box 5094, Donaldson Station

CLEAN* SEPARATION

*99.9% plus with

YORKMESH DEMISTERS

(MIST ELIMINATORS, ENTRAINMENT SEPARATORS)

YOU present your problems...

YORK will recommend and deliver the answer!

Why not take advantage of our vast experience in improving the performance of process equipment. In the past 10 years, the outstanding success of thousands of installations is proof of the superiority of YORKMESH DEMISTERS for entrainment control.

Yorkmesh Demisters are used to improve product quality, to avoid losses, and to increase thruput capacity. Our engineers will give careful consideration to the information you submit and will recommend the best answer to your problem.

YORKMESH DEMISTERS

improve the performance of:

Vacuum Towers • Distillation Equipment • Gas Absorbers • Scrubbers • Evaporators • Knock-out Drums • Steam Drums

YORK

OTTO H. YORK CO., INC.

6 CENTRAL AVE. • WEST ORANGE, N. J.

terial which are available. And it presents in tabular form thicknesses recommended to insulate pipe sizes from ¾ to 24-in. according to temperature and type of application. Types of applications include hot water, low-pressure steam, cold piping, and dual-temperature service. Write or call: **Baldwin-Hill Co., 214 Breunig Avenue, Trenton 2, N. J., for bulletin on Mono-Kover insulation.**

●

High-Temperature Pipe and Block Insulation. Calcium silicate insulations for temperatures up to 1,200° F. are described in this new six-page folder (A.I.A. File 37-D-2). The bulletin gives basic sizes of insulation for pipe covering and block for process vessels or other equipment. Physical properties are tabulated and thermal conductivity given in graph form. Tables give simplified thickness standards for pipe coverings that permit nesting of layers. For temperatures between 600° and 1,200° F., tables on block and pipe covering give recommended thicknesses (nominal) for double layers. **Write or call: Ehret Magnesia Mfg. Co., Valley Forge, Pa., for Bulletin (A.I.A. File 37-D-2).**

●

Manual of Laboratory Safety, a compact pocket-size, fully illustrated publication, covers accident prevention, first aid, fire prevention, and safety equipment and concludes with a safety bibliography. It also has a section on handling radioactive materials. **Write or call: Fisher Scientific Co., 381 Fisher Building, Pittsburgh 19, Pa., for "Manual of Laboratory Safety."**

●

Chemical Relief and Back Pressure Valves. New Bulletin 357 describes Milton Roy Co. chemical relief valves and back-pressure valves. The four-page two-color bulletin gives complete specifications, including capacities of four standard sizes—¼, ½, ¾, and 1 in. It includes dimensions and materials of construction. The relief valves are used with corrosive liquids to 1,500 psi. The back-pressure valves are used to pressures of 200 psi. The topworks of both valves are protected by Kel-F or Teflon diaphragms. **Write or call: Milton Roy Co., 1300 East Mermaid Lane, Philadelphia 18, Pa., for Bulletin 357.**

●

Welded-Chain Comparison Chart, a new two-color sheet that opens up into an 8½ by 11-in. chart, compares the link measurements, load limits, and pounds per 100 ft. of the major welded-chain types, including proof, BBB, high test, Republic alloy, and crane (dredge) chain. The chart can be hung conveniently by means of a punched hole at the top of the sheet. **Write or call: Republic Steel Corp., 3100 East Forty-fifth Street, Cleveland 27, Ohio, for welded chain comparison chart.**

●

Screw Pumps. Basic construction and design of a line of standard screw pumps are shown in new Bulletin S-206, a six-page folder. The folder gives the features of both a double external-bearing and gear type and a double external-bearing and gear-hopper type of pump. **Write or call: Warren Pumps, Inc., Warren Mass., for Bulletin S-206.**

●

Standard Thermocouple Assemblies. Here's a new four-page bulletin illustrating and describing a variety of standard Serv-Rite thermocouple assemblies. The bulletin, No. TA-457, gives catalog numbers, sizes, prices, and ordering information. **Write or call: Claud S. Gordon Co., 3000 South Wallace Street, Chicago 16, Ill., for Bulletin TA-457.**

"SOUTHLAND BATTERIES . . . Custom-Built for the South"

Colonel Southland

SOUTHLAND BATTERY CO.

2040 Amelia • Dallas, Texas

"Custom-Built for the South"

MAP FILE

#MT4

Easiest way to file and find confidential maps, tracings, blueprints. Quality metal cabinet file with locking doors. 112 tilting tubes handle 60" prints. Tubes indexed for quick location. Ideal for field and home offices. Shipped from stock.

Patent No. 1610368. Other Patents Pending.

SCOTT-RICE CO., 610 S. Main, Tulsa 3, Okla.

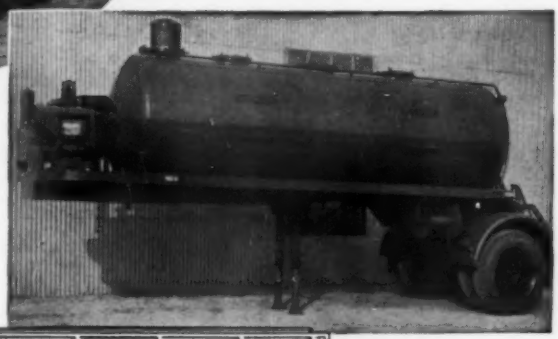
MOVING DRILLING MUD *FAST!*

Just for the record, this moving job during a changeover was timed, and here are the results: Exactly 8 minutes, 33 seconds after the driver yanked up on the emergency brake, 45 bbls. of 12 lb. mud was snugly inside the Thompson Unitized Vacuum Tank!

TO THE NEXT HOLE

From there to the next hole was discounted as driving time. Starting the stop watch again when the driver had backed up to the shaker pit, the one man laid hose, opened the valve and had the tank empty in 4 minutes 10 seconds.

This new Vacuum Tank Trailer, complete with engine and pump, is now available. Write for specifications and price!



GET ALL THE FACTS

There's a Thompson Unitized Vacuum Tank built to do your jobs fast, too! Cleaning tanks, draining sumps, pumping out cellars, agitating mud, spraying roads, weeds, etc., are everyday chores for this workhorse. Check UVTs: 20-100 bbls. capacity; truck, trailer, semi-trailer or skid mounted.

THOMPSON
TANK and MANUFACTURING CO. Inc.
2019 EAST WARDLOW RD. LONG BEACH 7, CALIFORNIA

SOLE LICENSEE TO MANUFACTURE VACUUM TANKS UNDER U.S. PATENT NO. 2522077

resort luxury
in downtown Miami

the new Fabulous Fourteenth floor—sumptuous one-of-a-kind rooms and suites for VIP's and truly discriminating guests!

the famed Top O' the Columbus—gourmet food; cocktails; supper dancing; panoramic views of ocean, bay, and city!

the convenient headquarters for your stay—downtown airlines terminal; near smart shops, theatres, and office buildings!

Completely air-conditioned

THE Columbus HOTEL
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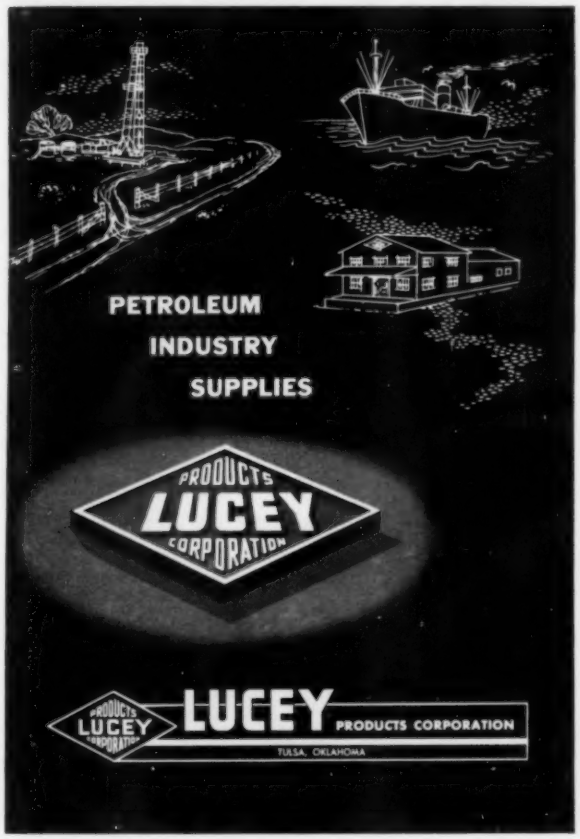
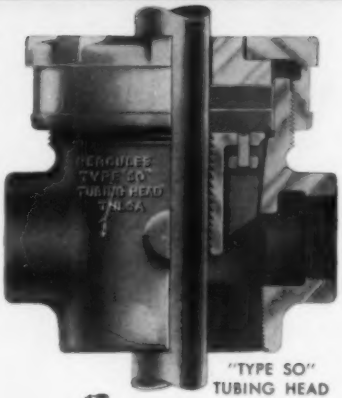
Miami, Florida



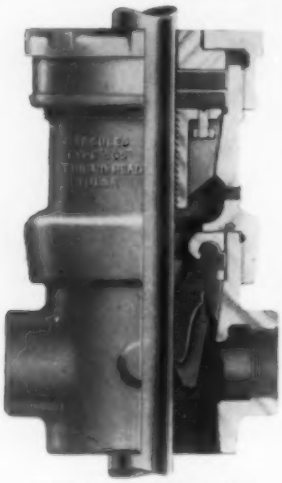
there's a Hercules tubing head

TO FIT YOUR REQUIREMENTS...

HERCULES "Type SO" Tubing Head is particularly suited for pumping due to compactness (only 12½" high). Stripper rubber can be used in body for running or wiping tubing. Also ideal for intermittently flowing wells.



"TYPE SO" TUBING HEAD



"TYPE SOS" TUBING HEAD

HERCULES "Type SO" and "SOS" Tubing Heads are the favorite of successful operators because of their simplicity, ruggedness and ease of operation. Available in 4½" OD to 7" OD Casing Sizes to suspend 2", 2½" or 3" tubing. Constructed from pressure cast steel and tested to 4,000 PSI. Slips are hinged for ease of installation and positive alignment.

HERCULES "Type SOS" Stripper Tubing Head is unsurpassed for use in well servicing operations as well as on flowing wells. It consists of a HERCULES "Type SO" Tubing Head with a bowl and Neoprene Tubing Stripper.

HERCULES TOOL Company

"MANUFACTURERS OF OIL FIELD EQUIPMENT" SINCE 1924

GENERAL OFFICES AND PLANT — TULSA, OKLAHOMA

Available through all supply stores: Export Representative: Oil Field Equipment Co., Inc., 30 Church Street, New York 7, N. Y.

for a cool one in the field...

HORTON water coolers

ORIGINATORS OF THE RECESSED SPIGOT

Horton Coolers are built to take it — under all field conditions. Rugged, heavy gauge steel • 3 interlocking channel supports between inner and outer bottoms • riveted handles • insulated with ground cork (or dead-air space) • 1½ to 15 gals. • Also stainless steel lined coolers in all sizes.

chrome-plated spigot

Contact your supply store or write:
SNELLING MANUFACTURING, INC.
P. O. Box 14503, Houston 21, Texas

"Pep-Up"®
The Original and Highest Quality
IMPREGNATED SALT TABLETS

- combat heat fatigue
- hold down hot weather accident rates
- help employees feel good and retain their vigor

Impregnated to Prevent "Salt Sickness". Each salt crystal individually coated to give slow, controlled dissolving, to prolong benefits and eliminate nausea.

Made and packaged by USSSCO under U. S. Patent No. 2,478,182

A SIZE AND PACKAGE FOR EVERY NEED

Select from list below. New all-plastic dispensers at no increase in price.

Item	Cat. No.
500 Tablets in Expendable Dispenser	1114
1000 Tablets in Expendable Dispenser	1124
1500 Tablets in Bulk Carton	1131
Carton, 72 "Vest Pocket" packets of 10 tablets each	1101

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Branches in Principal Industrial Cities
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EQUIPMENT MEN . . . in the News

Aerial view of new Garrett Oil Tools, Inc. plant in Longview, Tex.

Formal Opening Marks Completion of Garrett Plant

The new plant of Garrett Oil Tools, Inc., a division of U. S. Industries, Inc., was formally opened in Longview, Tex., recently. John I. Snyder, Jr., board chairman and president of U. S. Industries, Inc., was present at the opening, and the U. S. I. board of directors held its regular monthly meeting in Longview just prior to the opening ceremonies. Among the directors present were Thomas A. Morgan, a director of Shell Oil Co.; Warren Lee Pierson, chairman of the board, Trans World Airlines, Inc.; W. F. Wilmas, U. S. I. executive vice president; R. W. Glasner, president of Clearing Machine Corp. and vice president of U. S. I.; and F. L. Johnson, a director of Pullman Savings Bank.

H. U. Garrett, founder and president of Garrett Oil Tools, Inc., and Taylor Milton, Garrett executive vice president, guided the guests through the new plant.

The installation is located on a 40-acre tract east of Longview on U. S. Highway 80 and has a total building space of 86,000 sq. ft. Allowance has been made for possible expansion to some 491,000 sq. ft.

An interconnected administration section and shop comprise the main building. The smaller wing of this building houses executive and general offices, conference room, IBM section, cafeteria, and reception room. A larger connecting wing of this main building is devoted to production lines, welding facilities, final assembly areas, warehousing and shipping rooms, and operations offices.

Research and engineering functions are conducted in a separate building of similar construction. Offices, drafting room, experimental machine shop and a 1,000-ft. test well are housed in this building.

Production has started at the new plant and already indicates a substantial increase over former production at the old Longview plant.

Baker's District, Branch Managers Hold Sales Meeting

Management of Baker Oil Tools, Inc., Central division, Houston, recently held its annual meeting in Odessa, Tex., for the West Texas district. Branch managers from Abilene, Hobbs, Levelland, McCamey, Odessa and Snyder attended, as well as division and district staff engineers.

Seated: S. O. Timmons, Jr., Odessa; C. C. Taylor, R. W. Henderson, P. E. Hilton, and J. C. Burtner, Houston; J. T. Mitchell, Odessa; J. V. Bergman, Midland.

Standing: J. Edwards, Hobbs; L. E. West and R. L. Morris, Odessa; J. T. Brian, Abilene; E. L. Runnels, Hobbs; B. Mitchell, McCamey; J. Hoffman, Snyder; W. H. Laney, Odessa; M. R. Litchfield, Levelland; G. M. Anderson, Houston.

Bucyrus-Erie Names Mickle As Drill Representative

V. C. Mickle has been appointed a special representative in the well drill sales division of Bucyrus-Erie Co., South Milwaukee, Wis.

Mickle was manager of the water well division of George E. Failing Co. at Enid, Okla., from 1947 to May of this year. He also worked as a construction foreman, as a driller and tool pusher for Darby Petroleum Co. of Tulsa, and as a driller for Empire Oil & Refining Co. in Wichita, Kans.

Bovaird Appoints Enloe as Shreveport Representative

Bovaird Supply Co. has opened an office in Shreveport, La., with Ralph Thomas Enloe as its representative. This office will serve the Arkansas - Louisiana - Texas areas. This gives Bovaird 29 offices and stores in seven states: Oklahoma, Kansas, Illinois, Colorado, Texas and New Mexico, plus Louisiana.

Enloe, who has been with other supply companies, has a broad experience in selling oil-field supplies, specializing in heavy machinery.

Oilwell Makes Rocky Mt., Gulf Coast Appointments

Lindy C. McPherson has been appointed store manager at Glendive, Mont., for United States Steel Corp.'s Oil Well Supply Division, according to R. L. Armstrong, Rocky Mountain area manager. Floyd L. Kittelson and Donnie E. Bowers have been named as field representatives at Williston, N. D., and Paul L. Mallow, field representative, has been transferred from Williston to Farmington, N. M.

In the Gulf Coast area, Winifred B. Morgan, Jr. has been appointed field representative at Morgan City, La., and Harman Holcomb, Jr., field representative, has been transferred from Denver City, Tex., to Beaumont, Tex., according to M. F. Jones, Gulf Coast manager.

McPherson was employed by the division in 1954 at Powell, Wyo. Kittelson and Bowers joined Oilwell in 1952. Bowers was appointed field rep-

resentative at Glendive, Mont., in 1953 and store manager in 1954. Mallow served Oilwell from 1948 to 1950, returning to the division in 1952, and was appointed field representative at Williston in 1953. Morgan was employed by Oilwell at Houma, La., in 1956. Holcomb joined Oilwell in 1952 at Snyder, Tex., transferred to Denver City in 1953, and was appointed field representative at the latter location in 1955.

Waukesha Named Factory Dealer for American MARC

Waukesha Sales & Service Co., Houston, has been appointed as direct factory dealer for American MARC diesel engines, according to W. Denis Kendall, president of the engine-building company.

Waukesha Sales & Service will handle both the industrial and marine lines in the southern area, and in addition, will carry complete stocks of service parts for the present line of American MARC lightweight diesel engines and the predecessor line of Hallett diesels.

The American MARC line includes lightweight air and water-cooled diesel engines, as well as diesel electric plants and pumping units. The single-cylinder Model AC1 is rated at 6.5; and two-cylinder Model AC2 is rated at 14 b.hp.

New General Sales Manager Named by Cooper-Bessemer

G. C. WOODARD

Grant C. Woodard has been promoted to the position of general sales manager, according to Stanley E. Johnson, vice president and director of sales for The Cooper-Bessemer Corp., Mount Vernon, Ohio. Woodard joined the Cooper-Bessemer sales department as a sales trainee. Later he was assigned to the local sales department where he got actual field sales experience in Ohio, West Virginia, Kentucky, Tennessee and Michigan.

In March 1955 Woodard was advanced to assistant general sales manager, the position he held until his recent appointment.

Climax Names Distributor, Representative for California

The Shrimpton Manufacturing & Supply Co., Los Angeles, has recently been appointed distributor of Climax single-cylinder horizontal and 4, 6, 8 and 12-cylinder vertical and V-type oilfield engines for the State of California. Complete sales, service and parts stocking facilities are available at Los Angeles and at the branch house at Bakersfield.

James K. Slusser has recently been appointed district representative for California by Climax Engine Manufacturing Co. He will headquarter at Westminster. Slusser has specialized in oilfield engine sales and applications for several years.

Climax Engine Manufacturing Co., a division of Eversharp, Inc., has general sales offices at Chicago, a district office at Dallas, Tex., a manufacturing plant and foundry at Clinton, Iowa, and distributors throughout the country.

Dearborn Appoints Alm Mgr. Pittsburgh Pipeline Sales

JOHN H. ALM

John H. Alm has been appointed regional pipeline sales manager for the Pittsburgh district of Dearborn Chemical Co., Chicago, according to Robert A. Carr, president. Alm will handle sales of the company's NO-OX-ID coatings and wrappers for the protection of underground pipelines.

Alm has been with the company 18 years. Previous to his recent appointment, he had been industrial sales representative working out of Dearborn's Detroit office.

Oliver E. Auer Joins Procon Sales Staff

Oliver E. Auer has joined the sales staff of Procon, Inc., refinery, petrochemical and chemical-plant construction company. Auer has been assigned to Procon's chemical plants division.

Auer formerly was senior sales engineer of Girdler Co.'s gas processing division. Previously he was employed by National Lead Co., Missouri Portland Cement Co., and Socony Vacuum Oil Co.

McCullough Makes Eastern Division Sales Changes

Bruce January, sales engineer, has been transferred from the McCullough Tool Co. eastern division headquarters in Houston to El Campo, Tex. D. B. Petty, sales engineer, formerly at Hominy, Okla., has been transferred to Wewoka, Okla., and T. E. Austin has been promoted from sales engineer in the Oklahoma City sales office to branch manager at Medicine Lodge, Kans.

Foreign Guests Attend Meeting of Houston Nomads

Guests attending a recent meeting of the Houston Chapter of Nomads included: Gen. William P. Lee, Amarillo Air Force Base; Martin Newell, Tidewater Oil Co.; A. E. Albiston, Brown Drilling Co.; Walter Leabo, International Oil Co.

Seated: B. G. Frazier, International Oil Co.; A. J. Rowan, International Drilling Co.; and W. H. Mannon, Camdrill.

Schlumberger Holds Sales Meeting at Houston

Division sales managers and members of the headquarters sales department of Schlumberger Well Surveying Corp. met in Houston recently to discuss sales and service topics. In the front row are M. L. Millican, Midland; G. B. Sullaway, Houston; Clark Edgecomb, Houston; A. Perez, Lafayette, La.; C. A. Doh, Houston; W. D. Ford, Wichita, Kans.; L. Petty, Jr., Corpus Christi; and J. A. Williams, Shreveport.

Back row: J. A. Mullinax, Denver; R. R. Rieke, general sales manager, Houston; G. A. Griswold, Houston; W. P. Baker, Evanston, Ill.; G. C. Hepburn, Bakersfield, Calif.; W. H. Hartsell, New Orleans; B. L. Delleney, Dallas; W. S. Jones, representing Schlumberger of Canada, Calgary; R. P. Alger, Houston; C. C. Bush, Oklahoma City.

Young Radiator Names West Coast Representatives

Flournoy & Everett, Inc., Downey, Calif., has been appointed as engineering, sales and service representative for Young Radiator Co.'s shell and tube heat exchanger products in southern California.

For 16 years, Flournoy & Everett

"... and SOUTHLAND BATTERIES give Quality, Service and Price ..."
Colonel Southland
Southland
SOUTHLAND BATTERY CO.
2040 Amelia • Dallas, Texas
"Custom-built for the South"

Tex-Tube Transfers Sammis to Houston Area

The transfer of W. A. Sammis to Houston to help ease an increased workload in the Houston area has been announced by Tex-Tube, Inc. Sammis most recently was district manager for Tex-Tube in San Antonio.

Previously, Sammis was with Sheffield Steel Corp. 5 years and 6 years with Youngstown Sheet & Tube Co. as salesman in Houston and San Antonio.

W. L. Banks Heads Davison Chemical's Tulsa Office

Davison Chemical Co., division of W. R. Grace & Co., is establishing a new office at Tulsa to maintain sales and technical contact with refineries in the area on behalf of the company's petroleum catalyst department.

In charge is W. L. Banks, who has previously operated out of the Davison Houston office.

Caterpillar Offers Film On Pipeline Construction

A new, 16-mm. motion picture film, "Pipeline Documentary," has recently been released by Caterpillar Tractor Co. The film covers construction operations on famous pipelines of the North American continent and the part played by Caterpillar-built equipment.

Using examples of successful pipelines in the United States and Canada, the 18-minute film documents the recent growth of the pipeline construction industry. Narrated by television commentator Walter Cronkite, "Pipeline Documentary" tells the accomplishments of the pipeline constructors in developing this method of rapid fuel transportation to its present efficient level. Produced in full color, the movie describes such famous pipelines as Trans-Canada, West Coast Transmission and Muskrat.

OUR AIM:

TO BUILD BETTER PIPE LINES ON SCHEDULE AT THE LEAST POSSIBLE COST

Houston CONTRACTING COMPANY
GENERAL CONTRACTORS
Laurence H. Favrot • R. P. Gregory • Geo. A. Peterkin

OIL • GAS
GASOLINE
WATER PIPE LINES

2707 FERNDALE
HOUSTON 6, TEXAS

WAS THIS YOUR RIG?

The best blowout preventer won't work if your operating unit fails. Payne Blowout Preventer Operating Units have no equal for reliability and economy. Rugged, fast-acting Payne Pumps keep pressures up where they belong. New 2,000 psi service pressure Non-Separator Type Payne Accumulators have no *bladders* or *diaphragms* to cause expensive shut downs. They are assembled in multiple units for any required volume. Consider every angle in choosing your blowout preventer operating units – reliability first, availability, maintenance and, of course, economy. Payne units are doing a better, more economical job on preventer hook-ups throughout the oil areas of the free world.

Payne MANUFACTURING COMPANY INC.

P. O. Box 9278 Houston, Texas
Phone: WA 1-7379 • WA 1-2021 •
Night: HO 5-3804 • OL 4-5506 • OX 7-3309

Export: R. S. Stokvis & Sons, 17 Battery Place, New York 4, New York

has represented the industrial and oilfield division of Young Radiator. Products handled by this division include HC atmospheric radiators, MWC combination coolers, lube oil and gas coolers, supercharger intercoolers, engine jacket water coolers, and evaporative coolers.

Alten Foundry & Machine Expands Texas Operations

A series of moves will enlarge Alten's Texas activities, according to Warren M. Benson, vice president of Alten Foundry & Machine Works, Inc., Lancaster, Ohio.

W. B. HUDSON

W. B. (Bill) Hudson, formerly Alten's North Texas representative has been named Texas district manager. Hudson will headquarter at Odessa and supervise the opening of a new Alten warehouse.

Harold E. Newlon has been appointed to replace Hudson in the North Texas area. He has had oil-field experience in sales positions with several major supply companies.

Swartwout Names Wilmot To Manage Tulsa Office

Stephen K. Wilmot has been appointed manager of the Tulsa district office of The Swartwout Co. Prior to joining Swartwout Co. Wilmot was with Midwestern Instrument Co., Tulsa, as a service engineer. Wilmont will headquarter at the company's district office in Tulsa.

IBM Names Western Applied Science Representative

Alden F. Pixley has been appointed as applied-science representative in the petroleum department of the western region of International Business Machines Corp. Pixley will direct and coordinate technical planning in the application of IBM equipment to the specific needs of the petroleum industry, and will assist customers in the analysis of individual scientific and technical problems.

He will also train customer and IBM sales and applied-science personnel in petroleum applications of data processing, and will give lectures and demonstrations on the use of electronic computing systems in the petroleum field. His activities will cover 12 western states, Hawaii and Alaska, with headquarters in San Francisco.

Pixley joined IBM in 1955 as applied science representative for the company's Richmond, Calif., sales office.

Polyken Adds Distributor For Tape Coatings Line

The Polyken sales division of The Kendall Co. recently enfranchised Aetna Sales Co., San Francisco, to carry its protective tape coatings line. This distributor carries the complete Polyken polyethylene protective tape coatings line.

FOR SALES MEETINGS . . .
CONVENTIONS . . . VACATIONS

have fun . . . yet

GET THINGS DONE!

Western Hills is ideal for all group meetings, conventions and vacations . . . of course. Accommodations for groups up to 500. Every resort luxury . . . just an hour's drive from the Oil Capital of the World. Write Box 1590, Wagoner for rates, dates. Our sales manager will call at your convenience. Live better, rest better, work better at wonderful, wonderful

in beautiful
SEQUOYAH STATE PARK
on Oklahoma Highway 51, east of Wagoner

IN GALVANIZED STEEL BUILDINGS

Plasticool is a sunlight reflective coating that reflects away virtually all infra-red and visible light rays. Lowers inside temperature to within 1 degree of shade. Effective on all kinds of buildings. Can be applied to practically all types of surfaces.

COATING LABORATORIES INC.
319 SO. QUINCY • TULSA, OKLAHOMA

IMPORTANT NEWS

For former users of Western Electric Polar Relays

New Series PTW Polar Relay replaces WE 255A . . . and costs less!

Since Western Electric announced their polar relays are no longer available, many relay users have been looking for a suitable replacement.

Look no longer! Automatic Electric's new PTW Polarized Relay is the complete equivalent of WE 255A relays in data transmission circuits. And the PTW series offers outstanding advantages over the relays you have been using.

Lower cost, for one thing. Less maintenance, for another. A new concept of relay design assures adjustments that stay put practically forever. It's small . . . fast . . . sensitive. Adaptable for new or existing installations.

More good news—we can supply PTW series in practically any quantity—*and on short notice.* If you'd like a complete briefing before you order, write for Circular 1821. Automatic Electric Sales Corporation, Northlake, Illinois. *In Canada:* Automatic Electric Sales (Canada) Ltd., Toronto. *Offices in principal cities.*

AUTOMATIC ELECTRIC

A member of the General Telephone System - One of America's great communications systems

GENERAL SYSTEM

A. F. KNAPPENBERGER
DRILLING CONTRACTOR - OIL OPERATOR
GRAHAM, TEXAS

April 25, 1957

Mr. Gordon P. Street, President
The Wheland Company
Chattanooga, Tennessee

Dear Mr. Street:

We started using your pumps back in 1937 and have continued to do so to the present time. We now have one HP-8000 and one HP-14000 in operation, which we believe is the most economical pump on the market to operate today.

The above two pumps have been in operation for several years, with practically no cost to us at all.

We operate the two rigs in North Texas area and drill contracts, interest deals, and our own account from 2000 to 7500 feet.

Yours very truly,

K&H DRILLING COMPANY

By: A. F. Knappenberger
Partner

20-Year User

of

WHELAND SLUSH PUMPS

cites their

low-cost operation!

Currently in use by K&H are Wheland HP-8000 and HP-14000 Pumps:

". . . in operation for several years with practically no cost to us at all."

—A. F. Knappenberger, Partner

On location in North Texas, the Wheland HP-8000 pump which has performed so well for K&H Drilling Co.

At the side, left to right, are Mr. Alton Henley, Co-owner; Mr. A. B. Drake, Wheland representative; Mr. A. F. Knappenberger, Co-owner.

WHELAND

HP-8000 DUPLEX SLUSH PUMP
7-¼" x 12", 220 HP Nominal Input at 70 RPM

•

HP-14000 DUPLEX SLUSH PUMP
7-½" x 14", 350 HP Nominal Input at 60 RPM

•

Wheland builds a Complete Line of Efficient Slush Pumps.

Write for Detailed Bulletins.

WHELAND

ROTARY DRILLING MACHINERY

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Who'll Drill the First 5-Miler?

By Frank J. Gardner

THREE YEARS AGO this column concluded a story on deep-drilling trends with this remark: "How deep can we go? . . . The chief limiting factor at present is man's inability to sink a 5-mile hole."

Man has suddenly become able. Over in Oklahoma City, Parker Drilling Co. of Tulsa is assembling a big rig that will be capable of biting 30,000 ft. into the earth. Such equipment is a sign of the times, for the emphasis now is on **depth,** and it may well be that in another 3 years, a 5-mile hole will be commonplace.

Casual announcements . . . At the moment, 22,000 ft. seems to be the popular target for deep operations. The world's deepest hole, Richardson & Bass 1 LL&E-Humble "L," in Plaquemines Parish, Louisiana, reached a record 22,570 ft. early last year. Besides setting a drilling-depth record, that well confirmed for the first time that oil pools can and do exist below 20,000 ft.

Within the space of a week, two operators have announced 22,000-ft. wildcat projects. And both were quite casual about it.

In Caddo County, Oklahoma, Kenneth Ellison et al of Oklahoma City will sink a 22,500-ft. test on the long-known but unproductive Fort Cobb anticline; tentative location is in Section 4-9n-12w. Shooting for the Ordovician on this 90,000-acre structure is an ambitious project, for geologists believe it may be as deep as 23,000 ft. to the Bromide sands and about 24,600 ft. to the Arbuckle. The proposed location lies only about a mile northwest of Superior Oil Co.'s 1 Weller (Section 11-8n-12w), which at the time of its abandonment in 1947 was the world's deepest well, with total depth 17,823 ft. still in Springer-Pennsylvanian. Should Ellison carry out his plans to test the Ordovician, then, it's just possible that Oklahoma and the Fort Cobb anticline could reclaim title to the world's deepest hole.

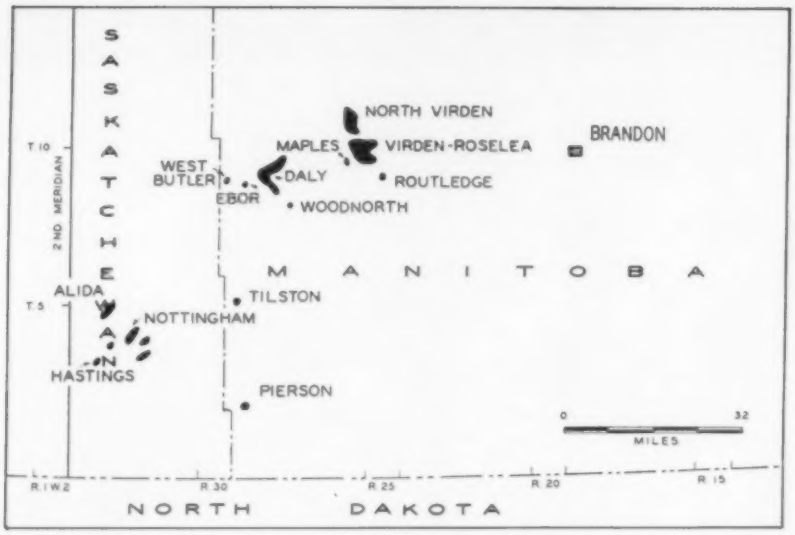
Reflect a feeling . . . The other 22,000-ft. wildcat is spotted far to the southwest, in Pecos County, Texas. Here, Phillips Petroleum Co. and Sinclair Oil & Gas Co. have revealed location for the 1 Montgomery "A," in Section 17, Block 134, T.&St.L. Survey; this put it 15 miles southeast of Fort Stockton and 14 miles due west of Puckett field, a 15,000-ft. Ellenburger producer. If carried to 22,000 ft., this wildcat would give Texas a new depth record. It is a hesitant step westward into the eastern edges of the big Delaware basin, where most geologists have a feeling that big pools of oil may lie at sub-20,000-ft. depths.

Pecos County is already the scene of a very active deep wildcatting campaign (see map); Phillips has two 18,000-ft. holes under way, while Pan American Petroleum Corp. has a 19,000-footer, and Humble Oil & Refining Co. an 18,000-footer. All of these lie within the Sheffield channel, an ancient seaway that is believed to have connected the Delaware and Midland basins, and success at any one of them would be an encouraging green light for a westward push into the depths of the Delaware. Oil hunters believe that the lush Mississippian, Devonian, and Ordovician reservoirs of the Midland basin also lie in wait in the Delaware, but at tremendous depths of 20,000 to 30,000 ft.

RECENT ANNOUNCEMENT of two 22,000-ft. wildcats has shifted the deep-exploration focus back to Oklahoma's Anadarko basin and West Texas' Pecos County. Presently, the world's deepest hole is in Plaquemines Parish, Louisiana.

And nature offers no veto . . . How deep can we go? There must be a limit beyond which we cannot logically expect accumulation of oil and gas in quantity, but the criteria for determining that limit have not yet evolved. Mechanical limitations and economic considerations are the only restricting factors to ever-deeper holes today, but even these are shrinking. And the presence of 65,000 ft. of drillable sediments in California, and 40,000 ft. in the Pacific Northwest and in the Green River basin offer no veto by nature to increasingly deeper exploration in the future.

LOCATION MAP shows Virden-Roselea and North Virden fields in Manitoba. Fig. 1. Article presented at First International Williston Basin Symposium, Bismarck.



With 400 wells drilled since discovery in 1953 . .

Virden Reserves Top 30,000,000 Bbl.

By C. A. Berg
California Standard Co.

VIRDEN-ROSELEA and North Virden fields, as presently defined, lie within Townships 9, 10, 11, and 12, Ranges 25 and 26, west of the principal meridian. The town of Virden, within Virden-Roselea field, is located 45 miles west of the city of Brandon, Man. (Fig. 1).

Virden-Roselea field was discovered in July 1953 by a random wildcat well and 5 months later North Virden field was discovered by a seismic-located wildcat well.

Virden-Roselea field has produced over 3,000,000 bbl. of oil and North Virden field has produced over 2,600,000 bbl. of oil. There are now approximately 400 wells (40-acre spacing) on production with 37 abandoned or suspended wells. Development of the fields is still in progress. Recoverable reserves are estimated at 11,000,000 bbl. for Virden-Roselea and 20,000,000 bbl. for North Virden.

Stratigraphy

Stratigraphic position . . . The reservoir rocks of North Virden and Virden-Roselea fields are part of the Lodgepole formation of early Mississippian age. The Mississippian rocks are underlain by Ordovician, Silurian, and Devonian sediments and are overlain by Jurassic and Cretaceous sediments and glacial drift. The Lodgepole lies at a drilling depth of 1,900 to 2,000 ft.

Basin position . . . The fields lie on the northeast flank of the Williston basin. The reservoir rocks are predominantly cyclical clastic limestone deposited in a stable shelf environment. Thin interbeds or argillaceous limestone enable the succession to be subdivided. Argillaceous equivalents of the coarse clastic rocks were deposited in a down-dip basinward position. These argillaceous limestones and calcareous shales were the probable source of most of the oil in the fields, with some oil possibly contributed by the Routledge shale facies within the Scallion member.

Description of Lodgepole Formation

The stratigraphic units of the Lodgepole formation in the Virden area were established by M. S. Stanton.[1] Stanton divided the Lodgepole into three members. (See Fig. 2.) These are, in ascending order, the Scallion member (including the Routledge shale facies), the Virden member, and the Whitewater Lake member. All are oil-bearing in the Virden area. The Routledge shale is a local facies at the lower part of the carbonate Scallion member.

Structure

The accompanying map (Fig. 3) shows structure on the top of the upper Virden member. This unit is well marked on the electric and radioactivity logs and is continuous over both of the field areas except for a few locations in the southeast corner of Virden-Roselea, where it is eroded. It also retains its character when dolomitized.

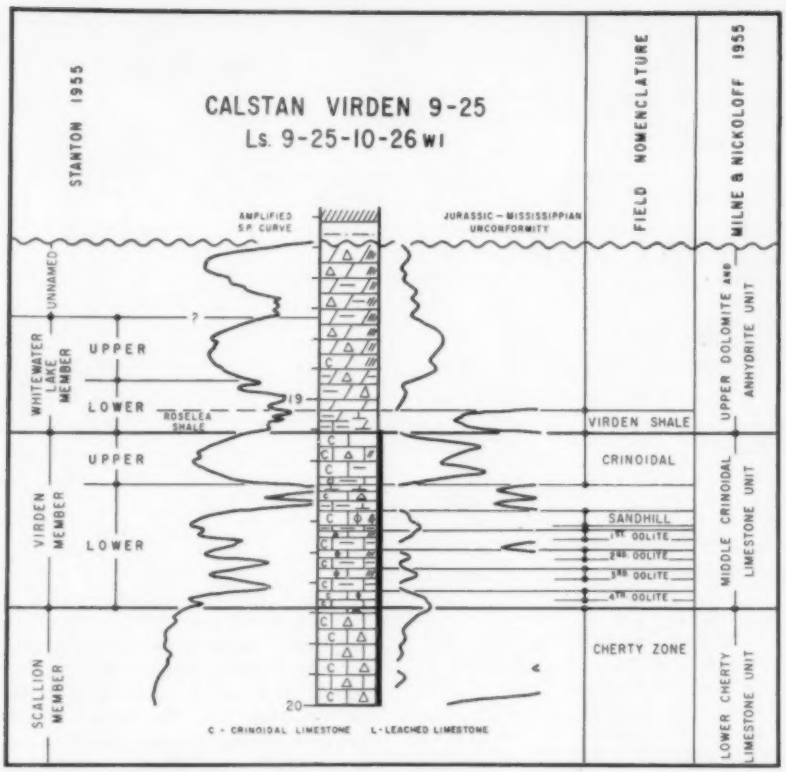
Scallion field is partly controlled by a true structural nosing with the structural or stratigraphic barrier at the north end not yet delineated. The map on the top of the Lodgepole erosion surface is similar to the true structure and the isopach map from the erosion surface to upper Virden member is quite uniform.

Virden-Roselea field is also partly controlled by structure although no complete closure has been outlined.

Type of Structure

Cores generally do not show displacement of beds across fractures which are intersected by the core. A few exceptions have been noted, all from wells in flank positions. An example is California Standard 11-23, Scallion which intersected an anhydrite-filled fracture that showed a displacement of 1 in. in the beds. In wells which are located stratigraphically low there is very little fracturing. It is obvious from the abundance of fracturing that the carbonates acted incompetently under the applied stress. Many fractures are less than 3 ft. long and die out in the argillaceous beds. Tension fracturing in the flank wells could be due to folding or to faulting.

British American-Union 5-28 Tapp and California Standard 1-15 Scallion



TYPICAL LOG of Virden field well showing nomenclature of upper part of preserved Lodgepole section. Fig. 2.

cored through breccia zones with the Scallion member. These zones were made up of angular fragments of chert, limestone, and dolomite in a shale and anhydrite matrix. It is believed that these zones are due to infilling of cracks extending to the erosion surface during the initial Amaranth transgression, and that they are not fault breccias.

Although the structure appears relatively abrupt the maximum dip outlined by drilling is less than 5°. Stratigraphic elevations of flank wells can be predicted from the dip established by other flank wells. The oil-water interface on the east side of the fields is stratigraphic and is present at the same horizon in all the flank wells. The above points and the abundance of fracturing with no displacement indicate that the structures are low-angle folds rather than high-angle normal faults. The fracturing that shows displacement is present on the upper flanks of the folds where minute faulting could be expected.

Origin

Atkinson and Hegion[2] made the following statement with respect to the origin of the structure:

"It is felt that uniform structural buildup does not exist, but rather that en echelon faulting took place as a result of down-warping and block faulting. This variation in the subsurface is possibly due to, firstly, movement within fluid beds at greater depths in the Devonian, and, secondly, from lateral movement within the basal Lodgepole shale (Routledge shale) which exists in this area."

The Routledge shale has a maximum thickness of 90 ft. in the south end of Virden-Roselea. This thickness is reduced to 20 ft. in the northwest and northern parts of the field. The structures outlined have relative vertical movements as large as 100 ft. in an area where the Routledge shale is 20 ft. thick. Similar structures exist in North Virden field where the Routledge shale is not present. Therefore I do not believe that Routledge shale compaction contributes to the major structures. It is probable that compaction of the shale results in differential settling of the overlying beds proportional to the thickness of the underlying Routledge shale but his settling is only of minor local importance.

Milne and Nickoloff[3] stated:

"The majority of evidence points to the existence of slump faulting due to solution of Devonian evaporites. Slumping was progressive, starting in Jurassic times and continuing through to late Cretaceous."

Isolated features of the nature present on the flanks of the fields are possibly due to such a mechanism.

Secondary Processes

Pre-Middle Jurassic leaching . . . Leaching of the exposed Lodgepole formation occurred during the pre-Middle Jurassic erosion period. Ground waters permeated the upper sections of the rock and leached much of the limestone. Silicification of minor parts of the rock concurrent with the leaching of the bulk of the rock possibly occurred during this period. Minor amounts of siliceous limestone, which have resisted later dolomitization, are considered to be of secondary origin.

The locus of the percolating waters was guided in part by the argillaceous

Source of the oil . . .

Virden-Roselea, and North Virden fields are located on the northeast flank of the Williston basin. They were discovered in 1953 and development is still in progress. The reservoir rocks are largely stable shelf, clastic limestone members of the Mississippian Lodgepole formation. These rocks are a combination of:

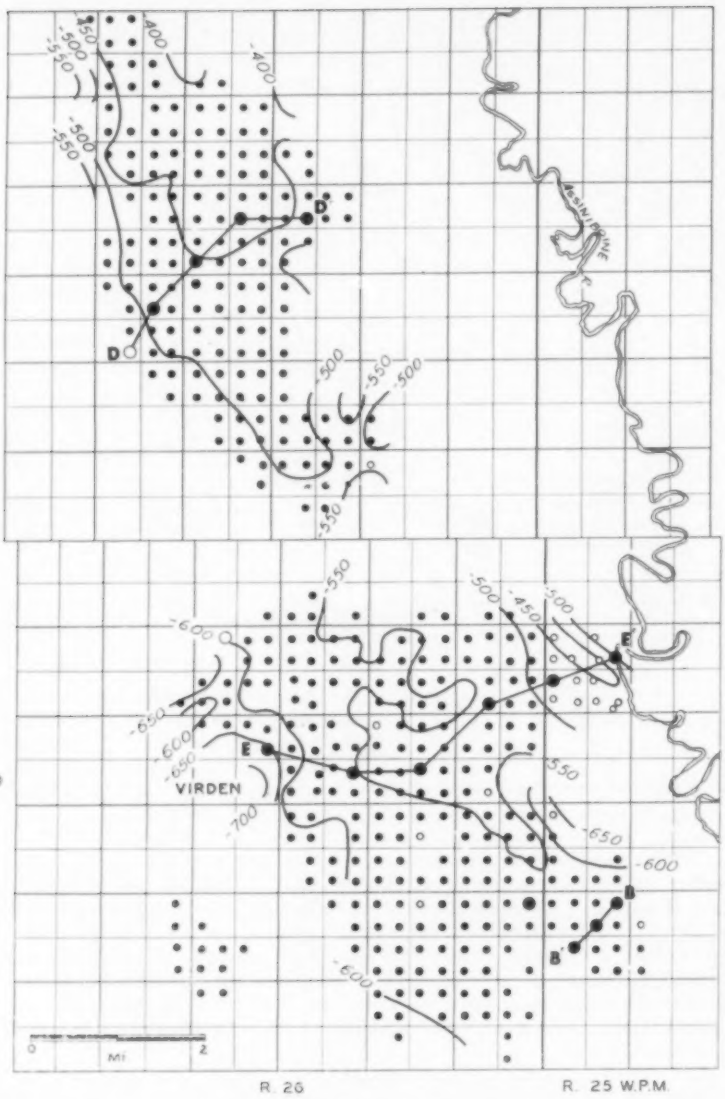
1. Local structural warping
2. Permeability barriers, from secondary effects which have formed the trap

These secondary processes in order of occurrences are:

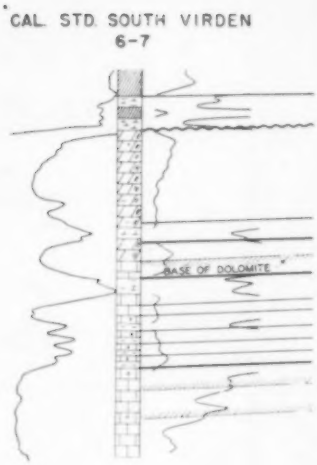
1. Leaching of limestone at the post-Mississippian unconformity
2. Dolomitization of the leached limestone during initial evaporite deposition of Amaranth (Middle Jurassic)) age, resulting in a major decrease in permeability and a minor decrease in porosity
3. Anhydrite infilling during later Amaranth deposition resulting in reduced porosity and locally in reduced permeability

Within any separate accumulation each individual permeable zone in the reservoir has its oil-water interface which, once updip from edgewater, becomes the base of the permeable zone.

It is probable that the main source of the oil is from the downdip shale and argillaceous limestone facies of the clastic limestone reservoir rock.



VIRDEN-ROSELEA AND NORTH VIRDEN structure contours on the upper Virden member. Fig. 3.



beds separating the reservoir units. The Roselea shale was impermeable and protected the underlying beds from the waters percolating through the Whitewater Lake member.

Since all of the reservoir units were exposed at the erosion surface, the percolating waters did penetrate them for some distance downdip from what are now their subcrops. The waters were also able to enter formations which were fractured due to pre-erosional structural movement. Over the fields the Whitewater Lake member was generally leached.

Within North Virden field much of the leached limestone in the Scallion member was not altered by the later magnesium-bearing solutions. As a result the mechanism of the leaching is discernible. The leaching has changed the texture of the limestone greatly and partly altered the structures within the rock. All gradations in textural changes are evident. The leaching solutions affected the most permeable beds first and attacked the less permeable beds later.

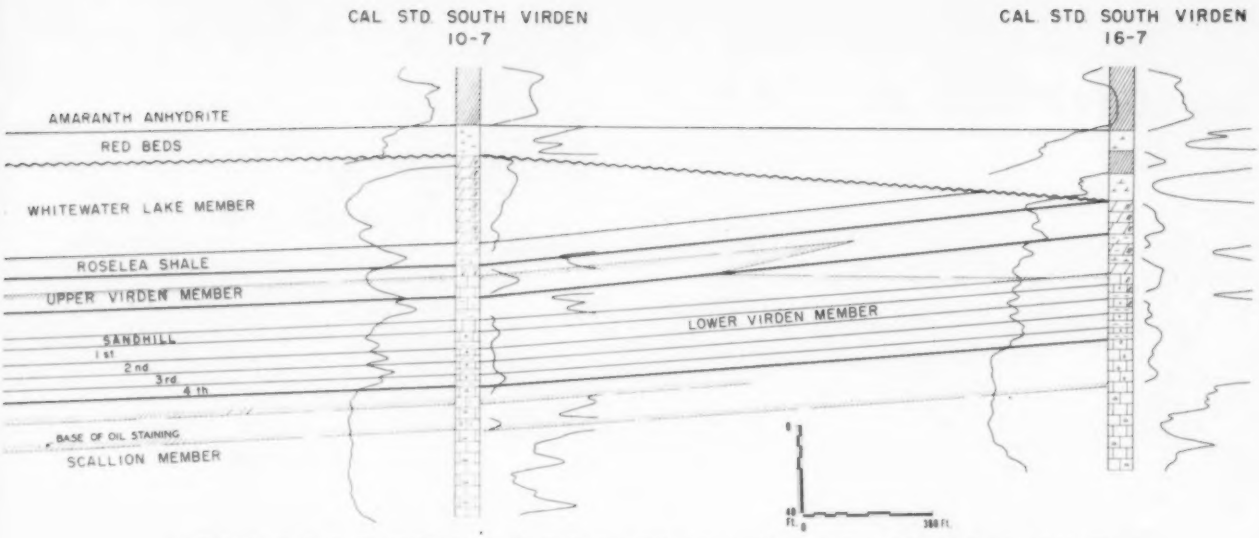
In some wells where the leaching was not carried to completion, the reservoir rock, originally a fine crystalline compact sediment, has thin interlaminated leached limestone within it. These leached laminae are more abundant within some intervals than within others. It appears that the leaching solutions attacked the very fine crystalline matrix material first and the fine crystalline texture of the rock was accordingly accentuated. In other areas where the leaching process is more complete the large crystals also were destroyed and no crystalline texture now exists. These beds have a typical weathered chalky mattelike appearance. In some cases these highly leached beds may be within a few inches of dense cryptocrystalline rock which shows no leaching effects; in other cases there may be a continuous leached zone of a few feet before denser rock is penetrated. The over-all thickness of the leached zone ranges from 20 to 50 ft.

There are many instances in which the chert nodules or the zones of chert nodules appear to be the most susceptible parts of the rock to leaching. In some cases the chert nodules and other rock structures within a leached section are almost completely destroyed and only careful examination will indicate their former presence.

Dolomitization

During the initial stages of transgression by the Middle Jurassic sea, the waters apparently had a high magnesium content. These marine waters easily permeated most of the leached limestone rocks below the unconformity and the limestone was replaced volume for volume by secondary dolomite. Some dense cryptocrystalline primary (?) dolomite may also have been implaced within voids of the rock. This dolomitization process reduced the permeability of the rocks which were formerly leached limestone. The magnesium-rich waters were not able to permeate easily the unleached limestones, and therefore the downdip equivalents of the leached surface rocks were not replaced by dolomite.

The secondary dolomite is medium to dark gray, laminated, and commonly has blind pin-point porosity. Relict structures and textures may be present.



SECTION B-B'—South Virden 6-7 to South Virden 16-7. Structural cross-section of Virden-Roselea field. Fig. 4.

The rock is in many places completely recrystallized and may be siliceous.

The primary (?) dolomite has a light brownish buff color, a dense cryptocrystalline texture, and lacks siliceous material. It is present in blebs and fine laminae within the secondary dolomite and as very fine interlaminae within beds of anhydrite.

Anhydrite Infilling

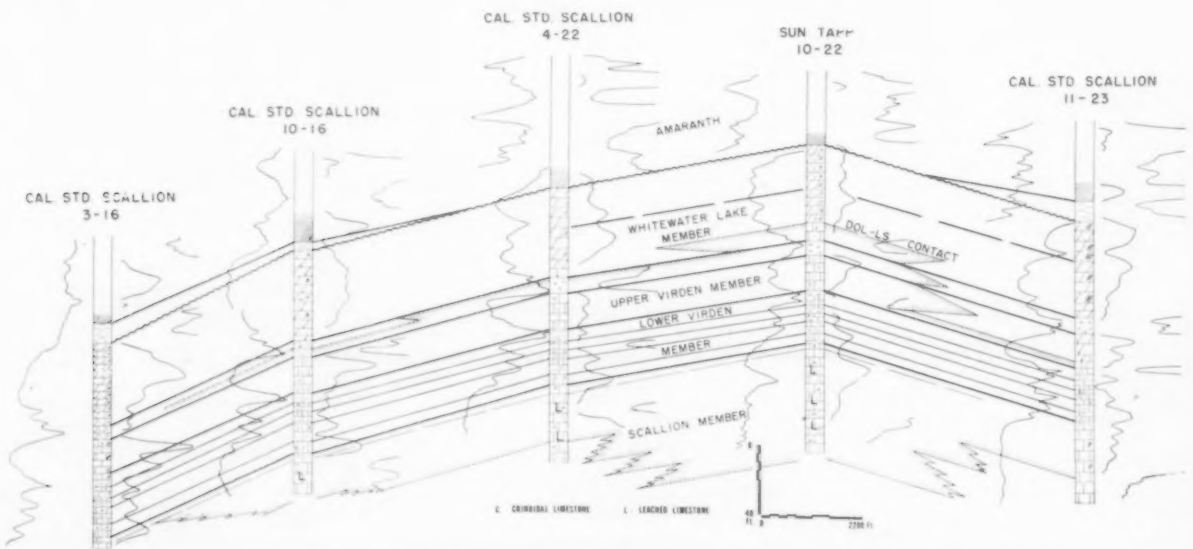
During the later stages of the Middle Jurassic transgression the waters were supersaturated with sulfate. These sulfate-rich waters permeated any fractures, open bedding planes, and vugs that were connected to the surface. The waters probably entered the vertical fractures and then spread into the bedding planes and open vugs cut by the fractures. Anhydrite was then deposited in these voids. There is some evidence of anhydrite replacement of some of the host rock. Most of this replacement occurred near the erosion surface. The greater part of the anhydrite occurs as secondary infilling of porosity. Many instances have been noted in which the anhydrite has penetrated a bedding plane or fracture and forced the surfaces apart. This mechanism commonly results in rubbly surfaces which are obviously complementary.

Instances have been noted, (e.g. in California Standard 1-15 Scallion), in which gypsum is associated with the anhydrite within the fractures.

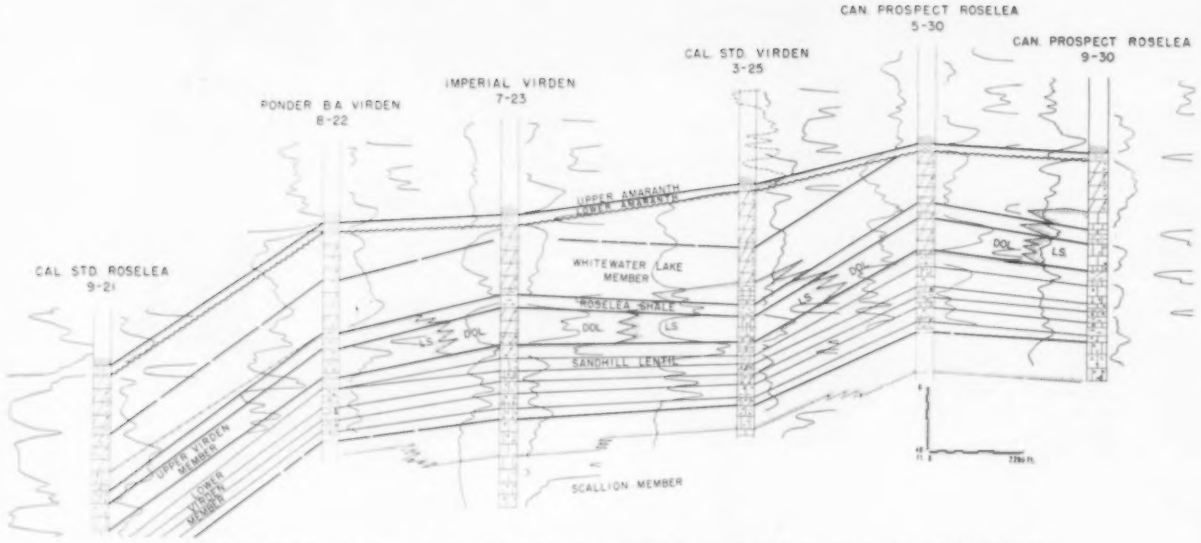
The infilling generally extends to a greater depth than the dolomitization. As would be expected, the rock closest to the erosion surface has the largest amount of intruded anhydrite along the bedding planes. Within the underlying limestone the anhydrite is present in fractures and vugs with rare anhydrite interbeds.

Effects of Permeability Variations

Effect of primary changes in lithology . . . The most marked permeability variations due to changes in the depositional fabric or the degree of cementation occur in the Scallion member. In Virden-Roselea field and in part of North Virden field, the producing interval of the Scallion member is composed of cryptocrystalline to fine microcrystalline and fine bioclastic limestone beds. These beds, except for the bioclastic unit at the top of the Scallion



SECTION D-D'—Scallion 3-16 to Scallion 11-33. Structural cross-section of North Virden field. Fig. 5.



SECTION E-E'—Roselea 9-21 to Roselea 9-30. Structural cross-section of Virden-Roselea field. Fig. 6.

member, are not laterally continuous. The lateral discontinuity of depositional fabric and degree of cementation results in lateral permeability variations. Oil preferentially selects the most permeable unit. Permeability variations thus produce lateral changes in the elevation of the oil-water interface.

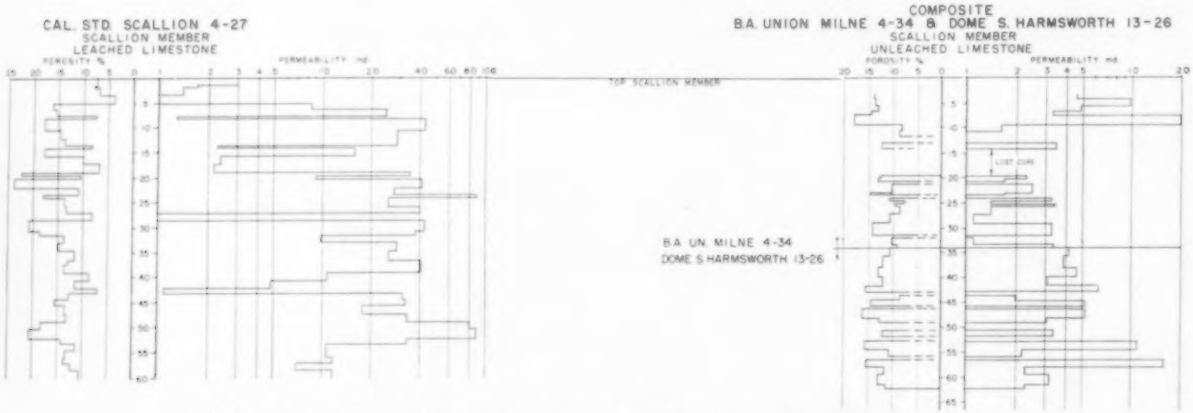
Each permeable oil zone has its own edge-water interface which will follow a constant elevation. Other units of different permeability will not necessarily have the same edge-water elevation.

Different parts of the fields have oil-water interfaces following the bases of different stratigraphic zones (Fig. 4). Within these different parts of the fields the oil-water interface follows the structure, (as in Section 7-10-25), and there are stratigraphic jumps in the water line between the different parts. On the southwest flank of the fields, close to edge-water position, these stratigraphic jumps are numerous. Farther updip the water line apparently becomes stabilized at approximately the same stratigraphic horizon. The east side of North Virden field and the northeast side of Virden-Rosalea field appear to have stabilized stratigraphic water lines which follow the structure.

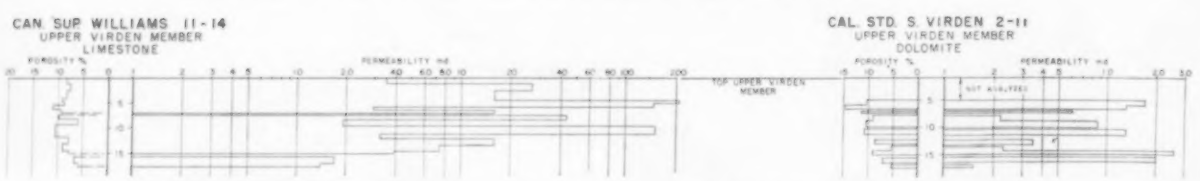
The other reservoir units of Virden-Roselea field have relatively more consistent permeabilities than the Scallion member and edge-water lines established in one part of the field are approximately the same in other parts.

In North Virden field the oolitic lentils thin and become bioclastic, with a progressive increase in argillaceous content northward across the field. This facies change results in a decrease in permeability and the lentils are then no longer significant reservoir rocks.

The upper Virden member is a tight impermeable bioclastic limestone in the southern part of North Virden field. This permeability barrier is downdip from the dolomite-limestone contact and the reservoir is offset to the southwest of this facies barrier.



COMPARISON of permeability and porosity in leached and unleached limestone. Fig. 7A.



COMPARISON of permeability and porosity in limestone and dolomite of upper Virden member. Fig. 7B.

Leaching of the Scallion member in North Virden field has only minor influence on the locus of accumulation. However, the leaching has greatly influenced the reservoir characteristics and well performances. The leaching solutions which passed through the member greatly increased the permeability and porosity within the area of movement (Fig. 7A). Permeabilities range as high as 500 millidarcies and the porosity ranges as high as 40 per cent in unfractured rock.

The permeability due to leaching has the same effect on the waterline position as the depositional permeability variations previously mentioned.

Effect of Dolomitization

Within any of the reservoir units the dolomitization process has formed an effective permeability barrier to the further migration of the oil. The oil staining is greatly reduced with a unit after it passes through the dolomite-limestone contact. Wells completed in oil-stained dolomite are not expected to match the performance of wells completed in limestone, owing to the decrease in permeability (Fig. 7B).

Maples field, to the southwest of Virden-Roselea, owes its existence to that location to a rapid stratigraphic drop of the dolomite-limestone interface within the Whitewater Lake member and the overlying unnamed unit.

Effect of Anhydritization

Anhydritization and anhydrite infilling have not had a significant effect on the loci of accumulation. The anhydrite has reduced the porosity of the reservoir rocks. In a few wells anhydrite has completely permeated the reservoir rock and reduced the permeability around the bore hole so greatly that the wells have been abandoned. These abandonments are local occurrences and there is no lateral pattern to the abundant anhydritization.

Acknowledgment

The author wishes to thank California Standard Co. and Standard Oil Co. of California for permission to publish this article.

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Kermac Rig No. 46 is unique in more than its size: its single deck is supported 100 feet above the water on a grid system of tubular floats; the derrick and draw-works can be shifted so the rig can drill as many as six holes without refloating; and the draw-works can serve as a crane to install well protection platforms, eliminating the need for a separate derrick barge.

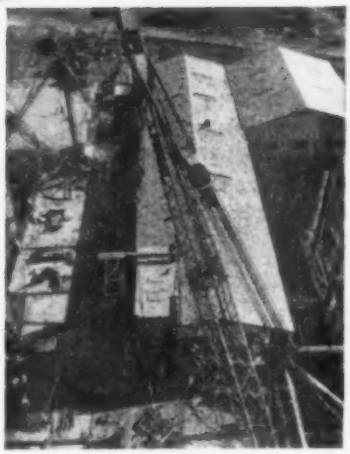
Butler buildings protect equipment on world's largest drilling barge

Engineers at Ingalls Shipbuilding Corporation, builders of the $3,500,000 Kermac Rig No. 46, had some unusual requirements for the metal buildings that were to shelter engines and equipment on this sea-going giant. Not only should the buildings perform the normal shelter functions, but they also had to be strong enough to withstand hurricane-force winds, continuous exposure to highly corrosive salt air and constant vibration due to drilling operations.

In the opinion of Ingalls, Butler buildings best met these requirements. Butler's rigid-frame structure provided the necessary strength with a minimum of top-side weight. Galvanized Butler panels insured corrosion resistance. And Butler's unique panel fastening method provided the security that was needed to keep the buildings from literally shaking apart.

Quality features like these have made Butler buildings first choice in oil fields all over the country. Their economy and durability make them ideal for warehouses, treater houses, maintenance shops, machine and tool shelters. Yet, Butler buildings are so easy to treat architecturally and insulate that they are often used for field offices and company stores.

For details, contact the Butler Builder nearest you. He's listed in the Yellow Pages of your phone book under "Buildings" or "Steel Buildings."



Construction of the Butler buildings was an easy job for Ingalls steel workers since all parts were pre-fabricated by Butler. This eliminated field drilling and cutting. Note the flexibility of the Butler building design which permits installation of a bulk materials hopper in the roof of nearest building.

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EXPLORATION HIGHLIGHTS

APPALACHIAN

OHIO

Portage County Wildcat Is Small Oil Discovery

A wildcat test in Brimfield Township, Portage County, made a small producer from Red Clinton at 4,136-97 ft. The completion by East Ohio Gas Co. on 1 T. Heichel Community, Lot 22, gaged 30 bbl. of oil and 150,000 cu. ft. gas after fracture.

● A 1,500-ft. south extension to the new production in Knox Township, Holmes County, made 140 bbl. and 2,425,000 cu. ft. gas in 24 hours after fracture. Clinton sand in the well, Oxford Oil Co. 1 G. Young, Section 24, was logged at 3,222-40 ft. with a good showing natural.

● Frank Brendel Oil & Gas 4 J. Ashcraft, Section 7, Jackson Township, Muskingum County, in the east end of the old Perryton pool, gaged 415 bbl. in a 24-hour test after fracture from Clinton found at 3,162-3,213 ft.

PENNSYLVANIA

Indiana County Wildcat Flows Gas

In Armstrong Township, Indiana County, Southwest Pennsylvania, New York State Natural Gas Corp N-542 Florence Boden et al, wildcat, elevation 1,141 ft., resulted in 1,500,000 cu. ft. gas after fracture, rock pressure 2,200 psi. in 25 hours, Onondaga 7,237 ft., gas 7,261 ft., and 7,295 ft., Oriskany sand 7,373-7,399 ft. Total depth 7,401 ft.

WEST VIRGINIA

Clinton Sand Wildcat Announced in Roane County

In Geary district, Roane County, West Virginia, it has been announced that United Fuel Gas Co. has started drilling a wildcat test which will go to the Clinton sand or deeper. It is No. 2-8100 John H. Osborne et al, elevation 666 ft., Walton Quadrangle, 3.20 miles south of latitude 38 degrees 35 minutes and 1.17 miles west of longitude 81 degrees 15 minutes.

● Dry Fork district, Randolph County, Hope Natural Gas Co. 9999 U. S. A. Dept. of Interior, elevation 3,105 ft., had a final gage of 175,000 cu. ft. gas after fracture, rock pressure 2,000 p.s.i. in 114 hours, Onondaga lime 6,264 ft., and again at 6,353 ft., chert 6,362 ft., Oriskany sand 6,504 ft., with gas, total depth 6,720 ft.

Exploration This Week

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EASTERN KENTUCKY

Deep Wildcat Drilling in Cambrian

Eastern Kentucky's deep test, Fordson Coal Co. No. 28 is drilling at 5,755 ft. in Knox dolomite of Cambrian age. Well is being drilled by United Fuel Gas Co. northeast of the town of Sizerock and located on Left Fork of Elkhorn Creek, Leslie County.

A gas show of 29,000 cu. ft. daily was encountered from 5,753-48 ft. Previously water was had from 5,320 to 5,330 ft. Top of Knox is reported at 4,964 ft.

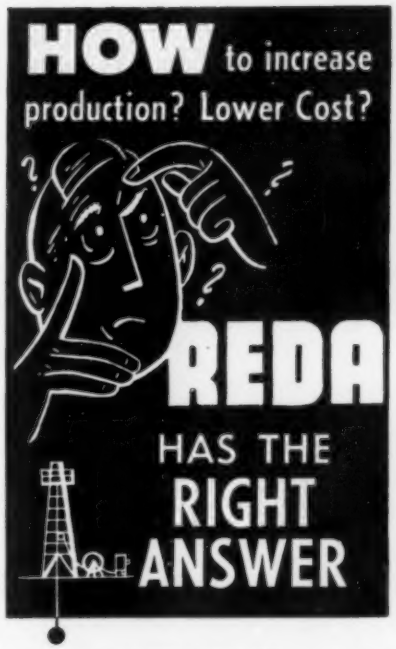
CALIFORNIA

Reserve Gets Big Well at Oxnard

Reserve Oil & Gas Co. brought in a big producer on the west edge of the Oxnard field in Ventura with completion of 1 Duntley, 660 ft. northwest of the nearest field producer. This extension was completed flowing at a rate of 1,176 bbl. daily of clean unspecified gravity crude through a 20/64-in. choke. Four hours after it was turned to the tank, the choke was cut back to 14/64-in. and the flow rate went to 636 bbl. daily. The well is believed producing from the Sespe McInnes zone at 6,380-6,518 ft. Total depth is 6,519 ft.

Recompletion Try Slated For Prado Dam Discovery

Lyle Garner abandoned the lower portion of the hole in his Prado field discovery well in Riverside County.



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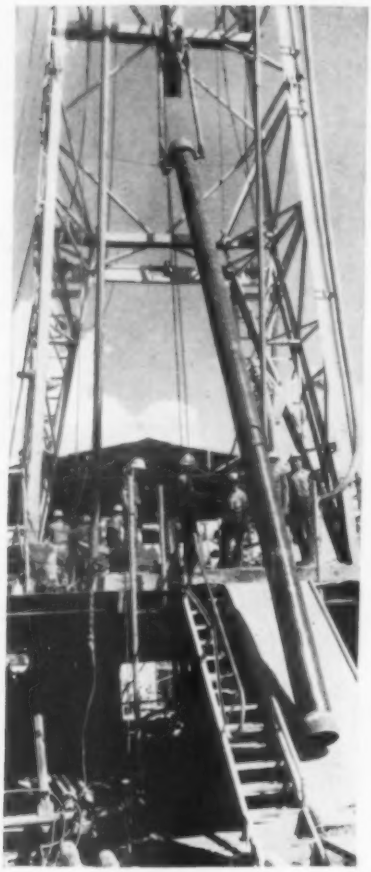

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The well, 1 G-G, has been plugged back to 3,360 ft. from 3,613 ft. The operator now plans to perforate 100 holes at 2,620-2,720 ft., 5 holes at 2,750-55 ft., 10 at 2,780-90 ft., and 15 between 2,810-50 ft. This wildcat was originally completed as a new field discovery in the Prado Dam area last April 1. It was put on the pump initially for 72 bbl. daily of clean 25°-gravity crude. However, frequent sanding up troubles plagued the deeper zone at 3,610 ft. resulting in the decision to plug it off and try for production at the shallower intervals.

CANADA

ALBERTA

Operators Prove Up 150 Feet of Pay at Innisfail

The Canadian Oil Companies, Ltd.-Security Freehold Petroleums, Ltd.-Calgary & Edmonton Corp. team opened up another 85 ft. of pay at the 1-16 Innisfail wildcat D3 oil discovery well and is now carrying out further drill-stem test in the horizon 30 ft. below the bottom of the last tested interval. This important discovery, 60 miles north of Calgary, has now proved 150 ft. of oil bearing reef in the Devonian. Latest test results showed a pipe recovery of 3,500 ft. of oil and 50 ft. muddy oil as well as 1,000 ft. of water cushion. The assured 150 ft. of pay at this well ranks it as the best D3 find in southern Alberta, but further drilling will be necessary to fully evaluate it.

SASKATCHEWAN

Mission Canyon Discovery Reported at Bellegarde

Mobil Oil of Canada, Ltd. has an indicated Mississippian discovery in the Bellegarde district of southeastern Saskatchewan. Two drill-stem tests run in the Mission Canyon had oil at 3,190 ft. Location is 4 miles west of the Manitoba border and 72 miles northeast of Estevan on LSD 9, 29-6-30w1.

ONTARIO

Wildcat Activity Reported In Southwestern Ontario

Bluewater Oil & Gas, Ltd., is currently drilling three exploratory wells in southwestern Ontario as part of a nine-well program scheduled for 1957. Three of the exploratory wells are to be drilled on Lake Erie where the company now has been granted 45,000 acres. An additional 20,000 acres has been granted to affiliates of the company and approximately 25,000 acres are under application.

The first Lake Erie well, Bluewater 1 Wheatley, was completed at 1,228 ft. on June 19. The well found a showing of gas in the Salina formation, and also 100,000 cu. ft. of gas, a very strong showing of light gravity green oil, plus some salt water in the Guelph formation of Silurian age. The pay zone did not appear to be thick enough at this location for commercial production so the well was plugged and abandoned. The well is located approximately 1½ miles southeast of Wheatley Harbour on a 15,000-acre block of licenses which is 100 per cent owned by Bluewater Oil & Gas, Ltd.

Bluewater Imperial 7-9 Sarnia was drilled to 2,775 ft. and abandoned on June 6. The well is located on a block of leases near Bright's Grove, Sarnia Township, jointly owned with Imperial Oil, Ltd.

Bluewater Imperial 7-12 Stanley was drilling at 1,026 ft. on June 20. This well is also on a block of leases jointly owned with Imperial Oil, Ltd. The well is approximately 5 miles south of Bayfield gas field. This field was discovered by Bluewater Oil & Gas, Ltd., in October 1956. It is jointly owned with Imperial Oil, Ltd., and at present has

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two shut-in gas wells whose combined open flow is 10,000,000 cu. ft. a day.

Bluewater Imperial 5-20 East Williams is a new location near Parkhill which is expected to start drilling on June 21.

Bluewater's Lake Erie wells are being drilled by Underwater Gas Developers, Ltd.

KANSAS

SOUTHWEST

Multiple Pay Discovery Completed in Morton

Panhandle Eastern Pipe Line Co. has brought in a multiple pay wildcat oil and gas well in Morton County, Kansas. The discovery is the 1-19 Tucker and is located in 19-34-41. The well originally tested at 360 bbl. of oil a day in the Cherokee sand at 4,400 ft. The well also recovered at the rate of 168 bbl. a day, before further treatment, in the Morrow sand at a depth of 4,675 ft.

Gas found in Greenwood field pay zones drill-stem tested 650 M.c.f. in the interval from 3,055 ft. to 3,210 ft. The latter gave this well approximately a 1-mile stepout to the presently determined limits of Greenwood gas field. The 1-19 Tucker lies within an 11,000-acre block of Panhandle Eastern owned leases and is "on trend" with Panhandle's Taloga field 2½ miles to the southwest.

A Mississippian oil discovery is indicated at Kansas-Nebraska Natural Gas Co. 5 Masonic Home, 9 miles northwest of South Side pool in Kearney County, inside the Hugoton gas field. The well is in C SW NW 34-25n-36w. A drill-stem test at 4,977-5,150 ft. got 1,090 ft. of gassy oil-cut mud in the St. Genevieve.

MICHIGAN

Deepened Oceana Wildcat Finds No More Pay

No additional Reed City zone pay had been logged by deepening from 2,587 to 2,615 ft. at Swan-King Oil Co. and W. L. (Bill) Harvey 1 Skidmore, SW NE NE 15-16n-16w, Crystal Township wildcat, Oceana County.

This wildcat showed for about 15 bbl. of oil a day natural on initial tests at 2,585 ft. Acid treatment with 1,000 gal. failed to increase oil flow, but rather appeared to decreased well's producing ability. Following acid treatment not more than an average of 5 bbl. of oil a day have been recovered by swabbing. If another 10 ft. of deepening (below 2,615 ft.) fails to increase opened pay in this objective well will be bridged for perforation and test in Dundee where a heavy gas flow accompanied with an unmeasured spray of oil were encountered. This Dundee zone was drilled 2,498-2,514 ft. Dundee top was logged at 2,496 ft. A long string of 5-in. casing was cemented in at 2,564 ft. before Reed City zone was penetrated.

● First Salina A-2 dolomite oil-gas test well in the old Diamond Springs Traverse oil pool, Heath Township, Allegan County, was drilled out dry in both this objective and the shallower Detroit River potential oil pay section. This failure was at The Taggart Co. 1 Confer, SW NE NE 1-3n-14w. Top of A-2 dolomite was logged at 2,479 ft. Well was cored to 2,644 ft., total depth.

NEBRASKA

CAMBRIDGE ARCH

Oil Discovery Hinted At Red Willow Wildcat

A wildcat test in Red Willow County, 6 miles south of the town of McCook in NW NW NW 29-2n-29w, recovered oil on drill-stem test of the Pennsylvanian.

The indicated discovery well is Mast Drilling Co. 1 Poore, 24 miles south of Barger field (the only production in the county) and 30 miles northwest of Cambridge arch production in Northwest Kansas' Decatur County. The test at 3,620-50 ft. got 380 ft. of gassy oil and 50 ft. of oil and gas-cut mud. Top of the Lansing-Kansas City Pennsylvanian is 3,620 ft. Another test as 3,655-95 ft. got 95 ft. of mud with oil specks. A third test in the Cherokee at 3,960-80 ft. got only mud.

NEVADA

Current Activity

Standard Oil Co. of California's wildcat in the White River Valley of White Pine County was standing cemented with 13⅜-in. casing at 570 ft. This well is located in NW NW 19-10n-62e in east-central Nevada.

OKLAHOMA

PANHANDLE

Important Beaver-Harper Link Well Staked

Success at a newly staked wildcat between Highland pool (Beaver County) and Northwest Laverne (Harper County) would link these two northwestern Oklahoma gas-producing areas. Oklahoma Natural Gas Co. staked 1 Mulberry Unit in NE NE SW 11-3n-28eCM, on the east side of Highland field and near the county line.

Both Highland and Northwest Laverne are multiple-zone gas-producing areas. Pennsylvanian and Chester-Mississippian production in this large area would be linked up by the new well. Location is 1½ miles west of Laverne district production. This section of the Panhandle and extreme northwestern Oklahoma has been one of the most active regions of the state in the past 2 years. Another fast-growing gas-distillate reservoir is the Southeast Stockholm field southeast of this Laverne production.

SOUTHERN

Success Indicated at Southwest Enville Well

A development well at Southwest Enville field, new Ordovician reservoir in Love County, is an indicated Oil Creek sand producer. The Texas Co.'s 1 Dexter, NW SE SE 7-7s-3e, flowed 1,015 M.c.f. of gas and 37 bbl. distillate in 11 hours on 7/64-in. choke from perforations at 8,705-15 and 8,725-35 ft. Testing indicates about 80 bbl. of distillate per million cubic feet of gas.

OREGON

Standard Quits Condon Wildcat

Standard Oil Co. of California has abandoned 1 Kirkpatrick at 8,726 ft. This wildcat was in the Condon region of Gilliam County in north-central Oregon. The rig was being moved to a new location in the Rattlesnake Hills of Benton County, Washington, 100 miles north of here, where it will begin work on an 8,000 ft. wildcat for Standard. This new Washington wildcat will be located 15 miles north of the town of Prosser.

• In other Oregon drilling, General Petroleum Corp. was moving in a rig to drill a wildcat, 1 Long-Bell, in the Sulphur Springs-Siuslaw area of Douglas County. Sunray Mid-Continent Oil Co. was waiting on a rig to drill a wildcat 20 miles north of Portland in Holbrook region of Multnomah County.

ROCKY MOUNTAINS

UTAH

Tohonadla Discovery Completed in Paradox

The westernmost production in the Paradox basin was officially established last week at Shell Oil Co. 1 Tohonadla in W½ SW SW 35-41s-21e, San Juan County. The well flowed 1,450 bbl. of oil daily on 48/64-in. choke on a calculated 8½-hour test of Paradox perforations at 4,990-5,050 ft.

WYOMING

Donkey Creek Confirmation Is Successful in Pennsylvanian

The Texas Co.'s confirmation well to the recent Pennsylvanian discovery at Donkey Creek in Crook County pumped 220 bbl. of oil per day, cut 14 per cent water. The 1 Stevenson NCT-2, C SW SE 8-49n-68w, is still testing. It is the confirmation well to True Oil Co.'s B-6 Burrows Pennsylvanian discovery in 8-49n-68w. That well flowed 28 bbl. of oil per hour.

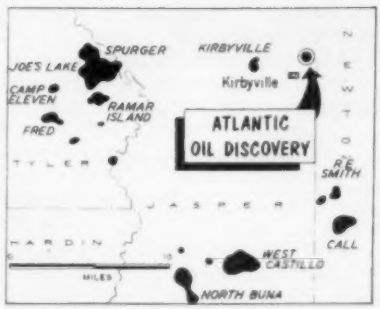
These Pennsylvanian deep tests at Donkey Creek have set off a flurry of new wildcat activity on the northeastern side of the Powder River basin.

TEXAS

GULF COAST

Jasper County Discovery Opens New Producing Area

Atlantic Refining Co. has a new oil discovery northeast of Kirbyville, on the east edge of Jasper County, 1,700 ft. from the Newton County line. Except for a small, isolated field (Kirbyville) 3 miles west of town, there is no other production within 10 to 12 miles. R. E. Smith field, nearest production (except Kirbyville) is 10 miles southeast, in Newton County. The more important Joe's Lake-Spurger producing area is 12 miles west in Tyler County.



LOCATION of Atlantic Refining Co.'s new oil-discovery well in eastern Jasper County.

Atlantic's discovery well, is 1 Henderson, in the J. L. Gebhart Survey, is productive from a 6,375-ft. sand (perforated at 6,376-82 ft.). It rated good for 119 bbl. of 41.1°-gravity oil per day, flowing through ⅛-in. choke. Its flowing pressure is 700 psi. Gas-oil ratio is 622 cu. ft. per barrel. Hole had been drilled to 9,261 ft.

Frio Sand Produces in Jefferson County Test

A wildcat located 4 miles north of Fannett, in northwestern Jefferson County flowed at more than 100 bbl. of 40°-gravity oil per day while clean-

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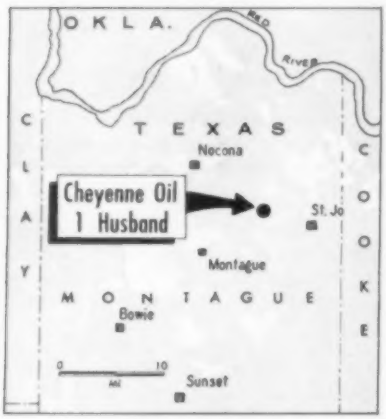
ing through 7/64-in. choke. Pressure through this choke was 1,350 psi.

The wildcat, drilled by Meredith & Co. and associates, is testing a Frio sand perforated at 7,975-79 ft. after plugging back from a drilled depth of 8,352 ft.

Location is about 2 miles southwest of Frio production in South China field, and about midway between that field and the Gilbert Ranch.

NORTH TEXAS



Cheyenne Oil Corp. 1 Husband in Montague County, indicated Bend discovery. Larger field immediately to north is Bonita (Strawn) field.

Portion of Montague County lease ownership map shows 1 Husband in C. Borger Survey in relation to nearby production. Courtesy Heydrick Mapping Co., Wichita Falls, Tex.

Montague County Assured Conglomerate Strike

Northeastern Montague County, from Montague to Saint Jo, was in line for another conglomerate pool at Cheyenne Oil Corp. 1 L. N. Husband.

This area has accounted for a few large producing structures, and numerous small pools, ranging in size from 4 to 12 wells. Until about 2 years ago the entire northern half of Montague County was getting close attention from wildcatters, then activity settled down to scattered exploration. Many operators apparently let a deep dry hole put the kiss of death on a wide area. Old time North Texas operators, on the other hand, condemn only that area directly under the dry hole. An equal drawback to exploratory drilling in some areas has been the problem of rounding up large numbers of land owners, even for small tracts.

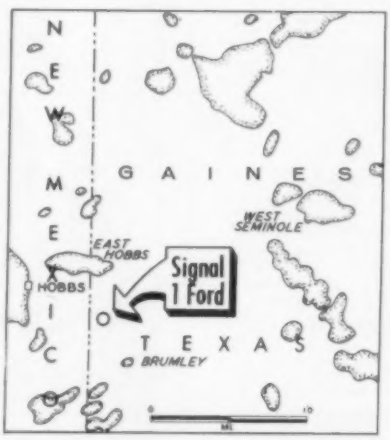
On the plus side, operators are looking at the prospects of oil from two zones. Primary objective has been the Bend conglomerate, found at depths ranging from 6,000-7,000 ft. Wells have varied from "small" to the 476-bbl. per day potential turned by P-M Drilling Co.'s opener of Dyemound, South field. Pay zone was the Bend at 6,770 ft. A secondary pay objective has been the shallower Strawn sand.

Standard tools moved in . . . Cheyenne Oil Corp. had moved off the rotary at its 1 Husband, 4 miles northwest of St. Jo, and was rigging up a standard rig for testing and completion.

While full details of the initial oil flow had not been released, the well had its first indication of production on a drill-stem test of the Bend conglomerate at 6,466-90 ft. The tool was open 1 hour. Gas surfaced in 3 minutes, and clean oil in 8 minutes. Recovery was a full drill stem of clean oil. Flowing pressure was 1,710 psi., and shut-in pressure reached 2,550 psi. Total depth was 7,100 ft.

Location of 1 Husband is on a 158-acre tract in Section 18, C. Boger Survey, A-65.

WEST TEXAS



Signal Oil & Gas Co. 1 Ford, discovery in southwestern Gaines County, swabbed 164 bbl. of new oil in 15 hours from the Devonian perforations at 9,170-72 ft.

WASHINGTON

Two Wildcats Active, One Idle in Washington

Utah Consolidated Oil Co. was testing a water shutoff at 4,357 ft. in 22-1 Swanson while the other Utah Consolidated wildcat in this region, Copalis Beach, Grays Harbor County, was temporarily suspended at 4,918 ft. with a bailer in the hole.

• In the other active Washington wildcat, McCulloch Oil Exploration Co. of California, Inc., was drilling ahead below 2,575 ft. on 2 Pasquier in the Enumclaw area of King County.

Successful Wildcats

PENNSYLVANIA

Indiana County, Armstrong Township: New York State Natural Gas Corp. N-542 Florence Boden et al, elevation 1,141 ft., 1,500,000 cu. ft. gas after fracture, rock pressure 2,220 psi. in 25 hours. Tully 6,675 ft., Onondaga 7,127 ft., gas 7,261 ft. and 7,295 ft., Oriskany sand 7,373-99 ft. TD 7,401 ft.

WEST VIRGINIA

Randolph County, Dry Fork district: Hope Natural Gas Co. 9999 U. S. A. Dept. of Interior, elevation 3,105 ft., 175,000 cu. ft. gas after fracture, rock pressure 2,000 psi. in 114 hours, Onondaga 6,264 ft. and 6,353 ft., chert 6,362 ft. Oriskany sand 6,504 ft., gas. TD 6,730 ft.

KENTUCKY

Muhlenberg County: G. S. Wittmer 1 Rufus Wells, 9-G-29. IPP 20 BOPD, McClosky lime 991-97 ft. TD 998 ft. Extension to South Rosewood and new pay.

ARKANSAS

Sebastian County: Reynolds Mining Corp. 1 Nichols, C NW SE 25-6n-30w. IP 1,500 M.c.f. of gas per day, Atoka 1,352-80 ft. TD 4,520 ft. New pay in Gragg field.

Miller County: Crow & Christmas 1 L. B. Brown, C SW NW SW 17-16s-26w. IPP 115 BOPD, 32°, Paluxy 3,221-24 ft. TD 4,395 ft. Opens Christmas pool.

Union County: Barron Kidd and Tandem Drilling Co. 1 Tatum, C NE SE 26-16s-17w. IPP 47 BOPD, Blossom sand 2,592-94, 2,596-98 ft. TD 6,396 ft. New pay in North Lisbon field.

CALIFORNIA

San Joaquin County: Arcady Oil Co. 2-10 Holt, NW SE 10-1n-5e, 1,900 M.c.f. daily, 12/64-in. choke, perfs. 5,263-71 ft., TD 5,350 ft. (New gas pool discovery 2 miles southeast of Whiskey Slough gas field and 1¾ miles northwest of Roberts Island gas field.)

ALBERTA

Richfield 7-29 Gabriel Lake, LSD 7, 29-40-3w5. Basal Quartz oil well. TD 7,282 ft.

BRITISH COLUMBIA

White-Lloyd 12 Blueberry, Unsurveyed. Mississippian gas well. TD 8,124 ft. 13 Blueberry. Unsurveyed. Mississippian gas well. TD 6,881 ft.

A Swede visits Denver:

. . . Aspegren Sees an Idea Work

SWEDISH soldiers fighting the army of Peter the Great supplied the idea that led to the Aspeco process for extracting oil from shale.

The process is now being tested by the Denver Research Institute at the University of Denver.

On hand for the first capacity run of the $100,000 Aspeco pilot plant was Olof Aspegren of Stockholm, Sweden —the 58-year-old mechanical engineer who helped develop the flameless retorting of shale oil.

The test was the culmination of 12 years' work on the method by Aspegren and the late Edvin Johansson, chief engineer for the Stockholm firm of consulting engineers formed by Aspegren 20 years ago.

How it started . . . He credited Johnasson's love of history with originating the process.

"He was reading in history books how the soldiers under Charles XII during the war with Peter the Great in the winter fastness of the Ukraine in 1708-09 supplied heat to the king's tent by heating cannon balls and piling them in pyramid form in the center of the enclosure," Aspegren explained.

"Johansson began thinking about how he could use heated balls as a means of transferring heat to other solid materials and we began working on the design of such a plant to utilize Sweden's shale reserves."

Aspegren said he acquired full rights to the process before Johansson died of cancer last October. Johansson designed the plant now being tested at the research institute.

The American dollars of H. E. Linden, president of Oil Shale Corp. of Beverly Hills, Calif., brought the process to the United States for further development under a $250,000 contract with the research center. The company so far has spent $500,000 on the 18-month-old project.

The 24-ton-a-day pilot plant uses a unique method of carrying heat to the crushed oil shale without exposing the shale to combustion.

Aluminum oxide ceramic balls about the size of walnuts are preheated to 1,200° F. and fed into a revolving drum where they meet the raw shale. The shale oil passes off as vapor and the spent shale, still containing coke-like carbon, goes to a combustion chamber where the carbon is burned with air to reheat the ceramic balls.

Estimates conservative . . . Aspegren predicts the process will make it possible for shale-oil producers to compete with petroleum from wells.

OLOF ASPEGREN

. . . Factory builder turned processor.

He said preliminary estimates of the efficiency of the process were conservative, adding that he expects the pilot plant to be able to handle more than the planned ton an hour. He claims the Aspeco process is 60 times faster and much less costly than other extraction methods.

Linden said he will be ready to negotiate for its use by domestic oil companies on a royalty basis after the research institute issues an evaluation report in September.

Aspegren said several countries in South America and Europe with sizable oil shale deposits are interested in the Denver plan. These include Sweden, Brazil, Australia, South Africa, Spain, Estonia, and Manchuria.

The Swedish engineer said, however, that he would not permit the use of his process in Manchuria or Estonia because they are under Communist governments.

Personals

Aspegren, married and the father of a son and daughter, received his technical education in Germany. He spent several years in that country and in England designing steel plants for a Swedish firm before he founded Aspegren & Co. in Stockholm.

His company has built steel plants in various European countries, including Yugoslavia, and is now erecting Portugal's first steel factory.

Allan R. Bailey, senior vice president of Southern Counties Gas Co., has been elected a director.

James B. Whatley, formerly geologist with Gulf Oil Corp. in Houston, has opened consulting offices there.

Edmund M. Foo, project engineer with Alberta Petroleum and Natural Gas Conservation Board, has joined Trans-Canada Pipe Lines, Inc., as gas engineer in Calgary.

Gordon O. Jerauld will leave Washington Natural Gas Co., where he is southern division general superintendent, in August to join Stone & Webster Service Corp. in New York.

LeRoy Whittaker, general superintendent of operations for George Noland Drilling Co., Inc., Tulsa, has been transferred to Thermopolis, Wyo., from Denver.

Darrel F. Mecham, district geologist at Bismarck, N. D., for Ohio Oil Co., has been transferred to a similar post at Salt Lake City. **Woodrow Wilson,** formerly area geologist at Cody, Wyo., succeeds Mecham at Bismarck. Wilson will be succeeded in Cody by **Leonard E. Thomas,** staff geologist there.

P. J. ANDERSON

Paul J. Anderson has been named senior representative in the United Kingdom for Standard Oil Co. (N.J.). He will continue as Middle East representative for the company in London. As senior United Kingdom representative, Anderson succeeds **H. W. Fisher,** who was recently appointed joint managing director of Iraq Petroleum Co. and its affiliate. Anderson has been with Jersey Standard since 1934. He became Middle East advisor for the company in 1952 and was named London Middle East representative earlier this year.

Personals

Standard of Ohio Presents 75-Year Service Award

George C. Baer, left, receives a 75-year service pin from Clyde T. Foster, president of Standard Oil Co. (Ohio). Baer is the first to receive a Sohio pin for this length of service as an active employe and as an annuitant. Baer was 13 when he joined the company in 1882 as a storehouse clerk. He retired as labor foreman at the company's No. 1 Cleveland refinery in 1929.

H. H. Bush, district petroleum engineer for The Texas Co. at Craig, Colo., has been promoted to assistant district superintendent of the Casper, Wyo., district. Bush joined Texaco in 1948. He was named district petroleum engineer in Lewistown, Mont., in 1952, and has been in Craig since 1956.

E. S. MARTIN

Eugene S. Martin, assistant superintendent of Shell Chemical Corp.'s Torrance, Calif., synthetic - rubber plant, has been named superintendent. He succeeds **G. S. Williamson,** who recently became manager of Shell's ammonia plant in the San Francisco Bay area. Martin was senior technologist with Shell Chemical in New York before transferring to Torrance in 1955.

R. A. Hobbs, Warren Petroleum Corp.'s district geologist in Tulsa, has been promoted to assistant chief geologist and transferred to Houston. **J. R. Simmons** will succeed Hobbs as district geologist for the Oklahoma, Kansas, and Texas Panhandle district. Simmons was formerly assistant district geologist in Roswell, N. M.

Jack M. Hazen has joined Vickers Petroleum Co., Inc., as chemist at the company's Potwin, Kans., refinery.

Quinton S. Drake has been transferred by Lion Oil Co. from El Dorado, Ark., to Houston as engineer.

John W. Scott has been appointed supervising construction engineer of The California Co.'s New Orleans engineering staff. Scott has been with Calco since 1948.

George S. Buchanan of Husky Oil Co., Cody, Wyo., and **Sheridan A. Thompson,** Magnolia Petroleum Co., Dallas, have been nominated for 1958 president of the American Association of Petroleum Geologists. Others on the slate are, for vice president, **Gordon I. Atwater,** New Orleans consultant, and **Claude N. Valerius,** Shreveport consultant; for secretary-treasurer, **Kenneth Cottingham,** Ohio Fuel Gas Co., and **Harold T. Morley,** Pan American Petroleum Corp. **Sherman A. Wengerd,** University of New Mexico, has been renominated for editor. A.A.P.G. officers will be elected by mail ballot and take office next March, after the association's annual meeting in Los Angeles. **Graham B. Moody,** Standard Oil Co. of California, is 1957 A.A.P.G. president.

H. J. Ward, Delta Drilling Co.'s general field superintendent in the Rocky Mountain division, has been transferred from Denver to Benghazi, Libya, where he will be in charge of Delta's operations. **C. W. Gold** has been named division drilling superintendent with headquarters in Casper, Wyo.

Harold R. Kemmerer has been promoted by Shell Oil Co. from assistant manager of the manufacturing research department to manager of products application department. He succeeds **A. B. Culbertson,** who has retired. **J. D. Heldman,** special technologist in manufacturing operations, succeeds Kemmerer.

E. W. BRAKE

E. W. Brake, Gulf Oil Corp.'s Oklahoma zone production superintendent, has been named district manager at Oklahoma City. **A. L. Latta,** assistant division chief geologist in Tulsa, has moved up to district manager at Wichita; and **A. C. Godbold,** division petroleum engineer with the company, will be district manager in Evansville, Ind.

A. L. LATTA

A. C. GODBOLD

The reassignments are the result of a change in organization of Gulf's Tulsa production division. Operations have been placed under districts and most of Gulf's zone offices have been eliminated. All three district managers are Gulf veterans. Brake joined the company in 1937, Latta in 1926, and Godbold in 1936.

W. W. Keeler of Bartlesville, Okla., executive vice president of Phillips Petroleum Co., will receive the 1957 All-American Indian award at the All American Indian Days celebration in Sheridan, Wyo., August 2-4. Keeler was selected for the award, presented annually to an outstanding American Indian, for his welfare and educational work among restricted Indians. He has been principal chief of the Cherokees since 1949.

Personals

Claud B. Barrett, Everett R. Filley, Theodore A. Mangelsdorf and **James T. Wood, Jr.,** have been elected senior vice presidents of The Texas Co. Barrett, formerly vice president at Houston, will be chief executive officer there. Filley, who has been vice president in charge of the domestic producing department, will assume responsibility for Texaco's world-wide producing interests. Mangelsdorf, also a former vice president, is in charge of the company's world-wide refining activities. Wood, formerly vice president in Los Angeles, becomes senior vice president and chief executive officer there. Elected vice presidents of the company are **J. B. Christian,** chairman of the board and managing director of Trinidad Oil Co., Ltd., now vice president in charge of Trinidad operations with headquarters in New York; **L. C. Kemp, Jr.,** general manager of the company's petrochemical department, now vice president in charge of petrochemicals; and **J. Howard Rambin, Jr.,** formerly assistant to the vice president in charge of producing department-domestic, now vice president in charge of that department succeeding Filley.

E. R. FILLEY

C. B. BARRETT

J. T. WOOD

MANGELSDORF

J. K. Alfred, manager of Shell Pipe Line Corp.'s operating services department in Houston, has been transferred to Flagstaff, Ariz., as field manager of the Four Corners crude-pipeline project. **G. C. Billings,** manager of the West Texas area for Shell Pipe Line at Midland, Tex., will succeed Alfred in Houston. **Horace E. White,** assistant manager at Midland, moves up to replace Billings there.

John C. Stone II, geologist with Carter Oil Co., has been transferred to Billings, Mont., from Carmi, Ill.

John E. Morrow, Jr., section chief of Sun Oil Co.'s products development division, has been named special representative, industrial products department. He succeeds **Dr. Archie B. Hoel,** who has retired.

Bruce Ramsey, operations consultant to the president of Interstate Oil Pipe Line Co., has retired. Ramsey joined Oklahoma Pipe Line Co., predecessor of Interstate, in 1920. He was vice president and general manager of Interstate before becoming operations consultant in 1955. He has been a director of the company since 1938 and a vice president since 1941.

W. C. Dennis has been promoted from Shreveport, La., regional geologist with Lion Oil Co., to chief geologist. He succeeds **E. D. Klinger,** who recently retired. **Tom L. Clifton,** Denver regional landman, has transferred to Houston as land manager of the company.

Harry L. Franklin has resigned as production manager for Harry Bass Drilling Co., Dallas, to form Harry L. Franklin & Associates, a new consulting firm specializing in drilling, production, and management problems. Franklin had been with the Bass interests 2 years. Before that he was representative for DeGolyer & MacNaughton in Rio de Janeiro and had also been with Shell Oil Co. in Venezuela and the Gulf Coast and General Petroleum Corp. in California.

Samuel K. McCauley, Atlantic Refining Co., has been elected president of Iricon Agency, Ltd. He succeeds **John W. Gendron** of Tidewater Oil Co. Also elected by Iricon are **A. H. Elliott,** of Iricon's London office, executive vice president; **David E. Day,** Richfield Oil Corp., vice president; **R. S. Stewart,** Standard Oil Co. (Ohio), vice president; **C. F. Krug,** Getty Oil Co., treasurer; **Harley C. Stevens,** American Independent Oil Co., assistant treasurer; **Harold A. Black,** Los Angeles, secretary and general counsel; **John K. Schemmer,** San Jacinto Petroleum Corp., assistant secretary. Elected directors were **Benjamin Tyran,** American Independent Oil; **B. H. Dresser,** Hancock Oil Co.; and **F. D. Lortscher,** Signal Oil & Gas Co. Iricon represents 5 per cent interest in the Iranian Oil Consortium held by American Independent, Getty Oil, Hancock Oil, Richfield, San Jacinto, Signal Oil & Gas Co., Standard of Ohio, Tidewater, and Atlantic.

B. W. CROFT

B. W. Croft has been promoted by Mountain Fuel Supply Co. from assistant manager of the producing division at Rock Springs, Wyo., to producing division manager. He succeeds the late D. K. Bowen. Croft has been with Mountain Fuel since 1946. He had been drilling foreman, assistant superintendent of production, drilling superintendent, and general superintendent of production before his new assignment.

E. A. Fuller has been named manager of pipelines in Calgary for British American Oil Co., Ltd. Fuller was assistant manager of Canadian Gulf Pipe Line Co. when it was acquired by British American in 1955. He has been assistant pipeline manager for British American since that time.

Newell Williams, manager of Union Oil Co.'s exploration in Guatemala and of Union's negotiations with the Guatamalan Government, has been named assistant to **Richard Harris,** general manager of Union's Latin American operations. Williams will handle all exploration and exploitation negotiations with Latin American governments. **Joel Lloyd,** manager of exploration and drilling for the company in Costa Rica, has also been named an assistant to Harris in charge of foreign exploration. Lloyd will be succeeded in Costa Rica by **Stanley Martin,** who has been in charge of drilling operations there.

DEATHS

R. Hal Compton, 58, Owensboro, Ky., oil producer, died June 21 in Mexico City after a heart attack. Compton was president of the Ohio Valley Gas Co., and was an organizer of Theta Production Co. and Alpha Drilling Co. of Owensboro.

Arthur Miller, Jr., 41, general sales manager of W. C. Norris, Manufacturer, a division of Dover Corp., died recently in Tulsa.

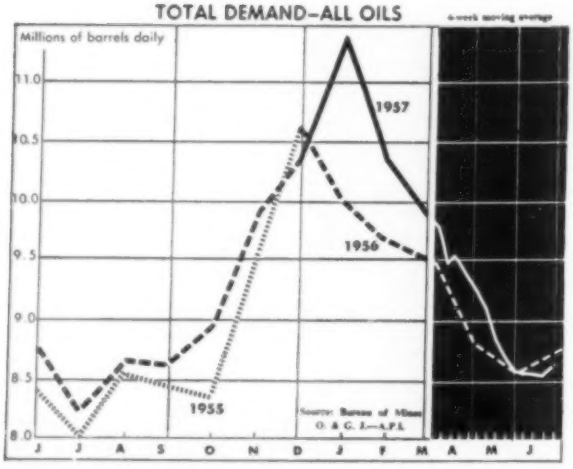
Eric P. Schelling, 64, Grand Rapids, Mich, independent, died June 24 after a long illness.

Jay Taylor Moore, 26, of Lamar H. Moore Drilling Co., Abilene, Tex., and **Johnny Howell,** 32, engineer with Baroid Division of National Lead Co., were killed June 27 when their light plane crashed near Farmington, N. M.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,216,775	DOWN	56,950	UP	109,708
Crude stocks	273,192,000	DOWN	1,035,000	DOWN	2,439,000
Completions	875	DOWN	160	DOWN	243
Refinery runs	7,915,000	UP	56,000	DOWN	229,000
Gasoline stocks	188,523,000	DOWN	702,000	UP	6,922,000
Kerosine stocks	28,212,000	UP	237,000	UP	2,433,000
Distillate stocks	114,997,000	UP	4,715,000	UP	21,325,000
Residual stocks	44,662,000	UP	777,000	UP	6,288,000
Four-product stocks	376,394,000	UP	5,027,000	UP	36,968,000
Total imports	1,783,900	UP	431,100	UP	537,500



Wholesale Product Prices Are Still Depressed by Surplus Inventories

PETROLEUM product markets open the second half of the year with wholesale prices depressed by overproduction. Stocks are too high for all products and in almost all areas.

Strikes at some refineries and voluntary cuts in runs at other plants started a reduction in product output in the last half of June. Product prices over the next 6 months will be influenced by the degree of the refiners' success in bringing supply in line with demand.

The following are comparisons of product prices during the first week of July with corresponding-period prices for the past several years.

The Mid-Continent area has more small spot sales than any other major marketing district. For this reason, the Group 3 market is more sensitive to market pressures.

Regular gasoline can be bought by private-brand distributors or jobbers for delivery at pipeline terminals at 11.25 cents a gallon plus pipeline charges. Large unbranded distributors may be able to buy for slightly less.

The price for regular last year at this time was 11.50 cents a gallon, but it dropped to 11.375 cents before the end of July and to 11.25 cents by the middle of August.

The following are the lows for regular gasoline early in July for the following years: 10.25 cents in 1951; 10.375 cents in 1952; 11.375 cents in 1953; 10.50 cents in 1954; and 10.75 cents in 1955.

There have been changes in quality over the years, but there has been very little change in price.

No. 2 fuel on the Group 3 market has a low of 8.75 cents a gallon, the same price quoted at this time last year. For other years since 1951, the price has ranged from 7.75 cents in 1952 to 8.25 cents in 1955.

The low for 92-octane regular gasoline on the Gulf Coast cargo market is 11.00 cents a gallon. This represents an increase of 0.25 cent from the low point reached early in June. Ninety-octane regular can be bought for 10.75 cents. For comparison, 90-octane gasoline was selling for 11.25 cents a gallon last year.

Over a period of 6 years, Gulf Coast regular prices have ranged from 9.75 cents in 1954 to 10.75 cents in 1951 and 1952. Gasoline quality has improved despite the small increase in price. For example, the average regular gasoline in Houston had an octane rating of 85.5 in 1951. In April of this year, the average was 90.8.

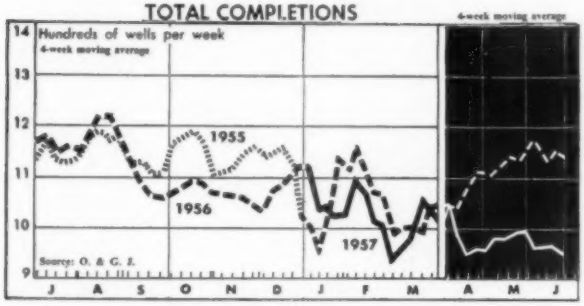
The No. 2 fuel market on the Gulf Coast has not been quite as soft as the gasoline market this year. Part of this firmness can be credited to export shipments that continued through April. Distillate exports totaled 5,266,000 bbl. last April compared with 2,620,000 bbl. for April 1956.

The low cargo price for No. 2 fuel on the Gulf Coast is 9.25 cents a gallon, up half a cent from last year. The lows of the midsummer market over the past 6 years have ranged from 7.5 cents in 1951 to 8.5 cents in 1953.

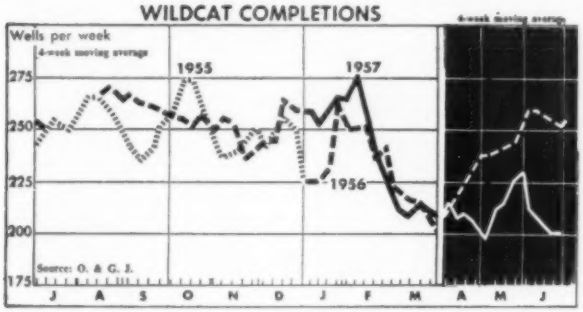
For the past few years the spread between kerosine and No. 2 prices on the Gulf Coast has narrowed. As late as 1954, kerosine was selling 1.0 cent a gallon higher than No. 2 fuel. For 1955 and 1956 the normal spread was 0.5 cent. This year the demand for kerosine has decreased enough to cut the price differential to 0.125 cent a gallon.

Domestic demand for kerosine through April of this year was 7.4 per cent less than last year.

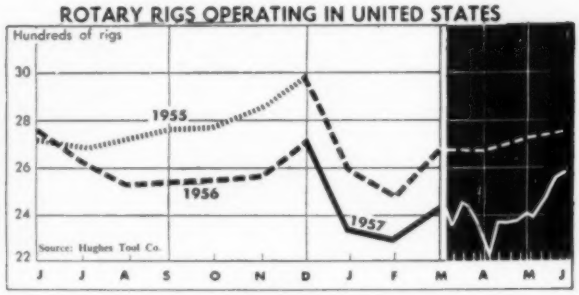
TOTAL COMPLETIONS



WILDCAT COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



ACTIVE ROTARY RIGS*

Area—	7-1-57	6-24-57	7-2-56
North Central and East	126	100	140
Southeast	51	52	29
Okla., Kans., Ark., Mo.	406	422	483
Louisiana	400	435	445
North and East Texas-Panhandle	437	439	413
Gulf and South Texas	213	216	259
West Texas-New Mexico	567	543	536
Rocky Mountain	269	249	277
Pacific Coast	111	108	126
Total United States	2,580	2,564	2,708
Canada	216	222	235

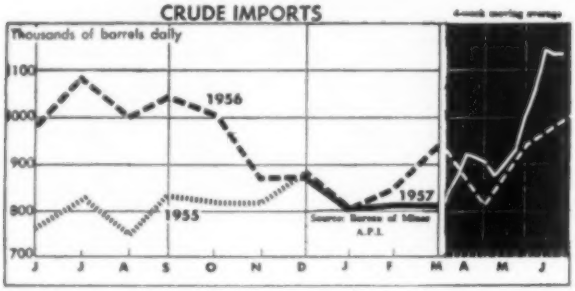
*Hughes Tool Co.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED JUNE 29, 1957

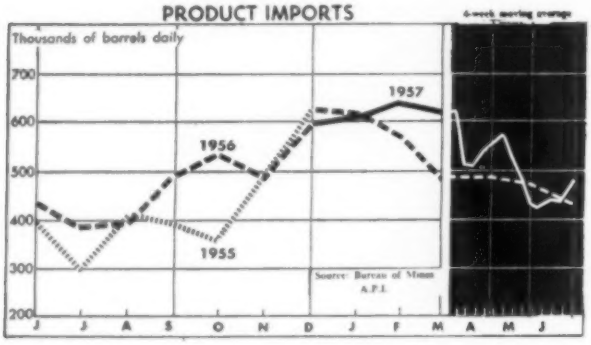
	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1957				
	Comp.	Oil	Gas	Dry	Footage	1957	1956	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	*2	1	0	1	19,732	57	52	0	0	0	1	1	0	0	1	20	21
Arkansas	35	16	1	18	119,267	491	386	0	0	1	10	11	12	0	5	73	90
California	35	23	2	10	138,571	1,045	1,086	0	0	0	7	7	30	0	5	221	256
Colorado	12	1	0	11	63,010	414	585	1	0	0	10	11	14	0	9	258	281
Illinois	47	17	0	30	111,652	1,186	1,805	1	0	0	10	11	14	0	1	277	292
Indiana	11	5	0	6	18,570	302	305	1	0	0	3	4	6	0	0	56	62
Kansas	85	40	8	37	304,709	2,028	2,537	2	0	4	14	20	52	0	17	331	400
Kentucky	22	7	2	13	33,360	666	838	1	0	1	5	7	14	0	5	112	131
Louisiana	70	32	8	30	642,936	1,853	1,935	0	0	2	16	18	39	9	50	240	338
North	18	11	1	6	73,788	614	791	0	0	0	3	3	7	0	5	67	79
South	36	14	6	16	409,146	877	922	0	0	1	11	12	22	8	37	146	213
Offshore	16	7	1	8	160,002	362	222	0	0	1	2	3	10	1	8	27	46
Michigan	12	4	0	8	33,933	195	229	0	0	0	5	5	9	0	0	74	83
Mississippi	7	2	0	5	56,481	185	218	0	0	0	5	5	10	1	0	84	95
Montana	14	7	1	6	48,110	182	175	1	0	0	3	4	6	0	0	58	64
Nebraska	17	7	0	10	101,812	390	524	1	0	0	8	9	20	0	1	198	219
New Mexico	37	23	10	4	194,323	1,029	915	1	0	0	3	4	32	1	8	97	138
Northwest	13	1	10	2	47,411	379	350	0	0	0	1	1	12	1	6	28	47
Southeast	24	22	0	2	146,912	650	565	1	0	0	2	3	20	0	2	69	91
New York	9	4	0	5	9,250	221	155	0	0	0	0	0	0	0	1	0	1
North Dakota	3	1	0	2	19,206	136	119	0	0	0	2	2	6	0	0	49	55
Ohio	16	9	3	4	40,856	519	510	1	0	0	0	1	1	0	0	3	4
Oklahoma	98	49	7	42	387,376	3,076	4,319	3	1	1	10	15	50	10	9	285	354
Pennsylvania	0	0	0	0	0	353	359	0	0	0	0	0	0	0	15	20	35
Texas	301	176	15	110	1,197,293	10,607	10,960	9	1	0	59	69	315	39	96	2,225	2,675
Southwest (1 & 4)	46	26	0	20	150,517	1,325	1,620	0	0	0	13	13	38	12	26	385	461
Gulf Coast (2 & 3)	34	19	3	12	212,724	1,256	1,339	1	0	0	3	4	26	17	44	316	403
East (5 & 6)	26	11	0	15	125,478	618	564	0	1	0	10	11	6	3	2	181	192
N. Central (7-B & 9)	93	48	0	45	236,274	3,728	3,960	6	0	0	23	29	166	0	14	943	1,123
West (7-C & 8)	63	47	1	15	332,844	3,003	2,850	2	0	0	9	11	74	0	8	368	450
Panhandle (10)	39	25	11	3	139,456	677	627	0	0	0	1	1	5	7	2	32	46
Utah	6	3	0	3	34,477	88	64	1	0	0	2	3	7	0	3	39	49
West Virginia	17	3	10	4	45,918	305	328	0	0	0	1	1	0	0	8	5	13
Wyoming	18	6	1	11	82,399	399	376	0	0	0	5	5	13	0	3	116	132
Miscellaneous (S. D.)	1	0	0	1	3,280	34	58	0	0	0	1	1	0	0	1	25	26
Total U. S.	**875**	436	68	371	3,706,521	25,761	28,838	23	2	9	180	**214**	650	60	238	4,866	5,814
Total previous week	1,035	516	77	442	4,420,527			16	0	6	199	221	630	59	229	4,702	5,620
Total June 30, 1956	1,118	557	98	463	4,307,899			31	1	13	218	263	776	67	206	5,253	6,302
Cumulative 1957	25,761	13,789	1,878	10,094	107,776,955												
Western Canada	82	56	3	23	369,165	1,321	1,232	2	0	2	17	21	34	0	27	291	352

Service wells included: *Alabama.

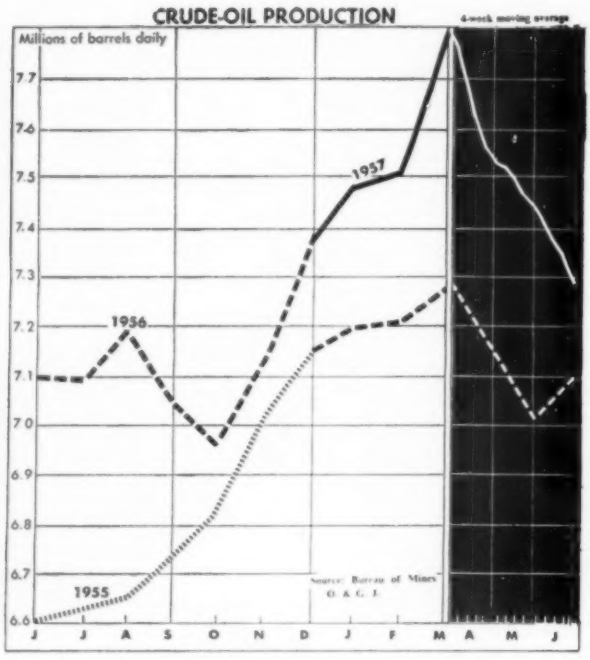
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION

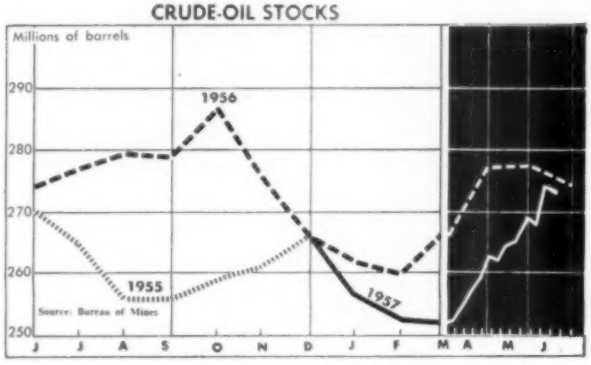


DAILY AVERAGE PRODUCTION FOR WEEK

	June 29, 1957			June 22
	Crude oil	Lease condensate	Total	total
Alabama	12,600		12,600	12,400
Arkansas	85,200	400	85,600	86,750
California	925,900		925,900	927,900
Colorado	148,600		148,600	150,900
Eastern	52,200		52,200	51,700
Florida	1,275		1,275	1,275
Illinois	155,000		155,000	163,300
Indiana	28,500		28,500	27,400
Kansas	†334,600		†334,600	†354,400
Kentucky	39,900		39,900	39,700
Louisiana	807,000	75,700	882,700	883,100
North	132,000	3,200	135,200	135,600
South	675,000	72,500	747,500	747,500
Michigan	24,900		24,900	28,700
Mississippi	110,600	4,500	115,100	115,100
Montana	74,600		74,600	74,350
Nebraska	51,800		51,800	52,150
Nevada	100		100	100
New Mexico	258,500	4,500	263,000	263,000
North Dakota	36,700		36,700	38,200
Oklahoma	†566,300		†566,300	†591,800
Texas	3,051,500	53,500	3,105,000	3,105,000
Dist. 1	53,500	450	53,950	53,950
Dist. 2	144,000	8,350	152,350	152,350
Dist. 3	435,000	26,200	461,200	461,200
Dist. 4	229,000	6,100	235,100	235,100
Dist. 5	40,000	300	40,300	40,300
Dist. 6	135,000	6,400	141,400	141,400
East Texas field	200,000		200,000	200,000
Dist. 7-B	167,000	75	167,075	167,075
Dist. 7-C	163,000	3,600	166,600	166,600
Dist. 8	1,170,000	1,100	1,171,100	1,171,100
Dist. 9	213,000	600	213,600	213,600
Dist. 10	102,000	325	102,325	102,325
Utah	7,600		7,600	7,700
Wyoming	304,700		304,700	298,700
Others	‡100		‡100	‡100
Total U. S.	7,078,175	138,600	7,216,775	7,273,725
Change from prev. week, down			56,950	
Canada	†548,960		†548,960	†552,000
Total U. S. prod.—Jan. 1-June 29			§1,354,817,975 bbl.	
Same period last year (crude plus cond.)			*1,297,063,925 bbl.	

*Includes 22,875,530 bbl. condensate. †Week ended previous Monday. ‡South Dakota. §Revised.

CRUDE-OIL STOCKS



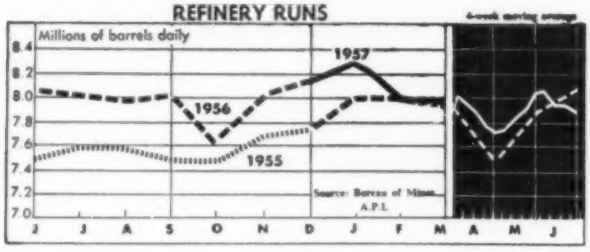
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

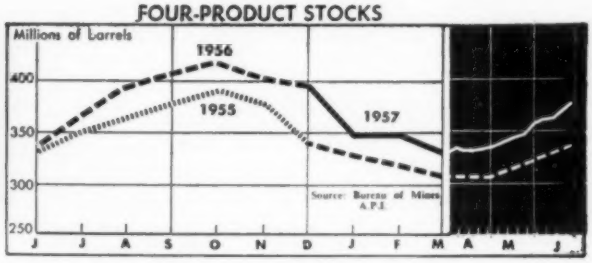
	6-22-57	6-15-57	6-23-56
Pennsylvania Grade	2,800	2,718	2,607
Other Appalachian	1,739	1,871	2,286
Illinois, Indiana, Michigan	9,446	9,483	11,301
Nebraska, North Dakota	2,224	2,416	2,681
Kansas	11,015	11,292	9,056
Oklahoma	21,133	20,995	26,754
Arkansas	2,622	2,861	3,031
Louisiana	18,465	18,392	15,518
North	2,770	2,818	2,537
South	15,695	15,574	12,981
Mississippi, Alabama, and Florida	2,580	2,566	3,094
New Mexico	7,785	7,941	7,432
Texas	128,628	127,829	123,958
East Texas proper	11,674	11,475	9,178
West Texas	61,884	61,342	60,447
Texas Gulf	24,133	24,312	22,402
Other Texas	30,937	30,700	31,931
Wyoming	16,649	16,798	18,735
Other Rocky Mountain	6,011	5,914	6,338
California	26,937	27,257	27,918
Foreign	†15,158	15,894	14,922
Total	273,192	274,227	275,631

*Bureau of Mines. †Includes 2,670,000 bbl. in California.

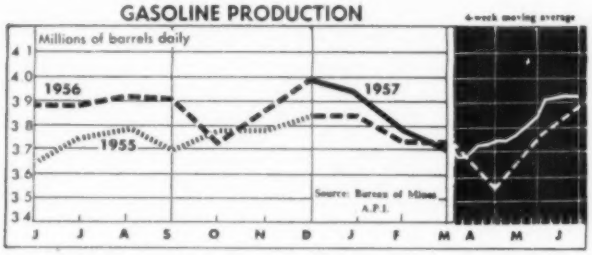
REFINERY RUNS



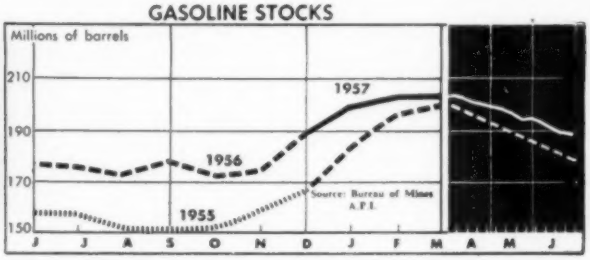
FOUR-PRODUCT STOCKS



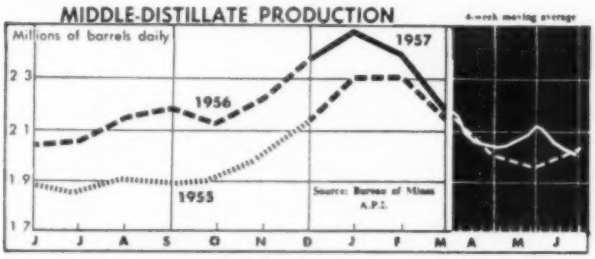
GASOLINE PRODUCTION



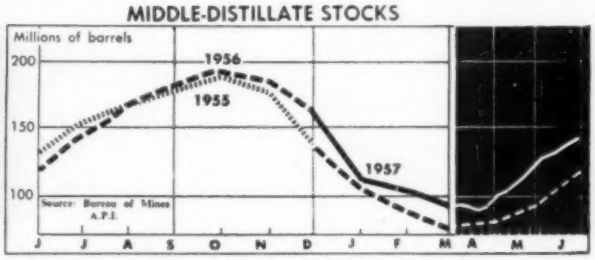
GASOLINE STOCKS



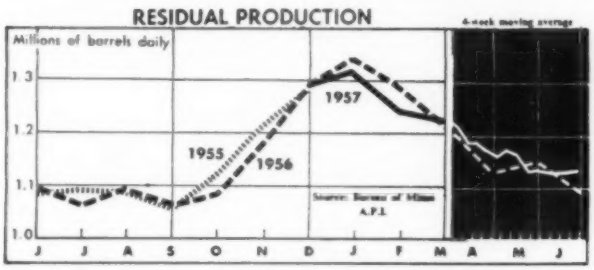
MIDDLE-DISTILLATE PRODUCTION



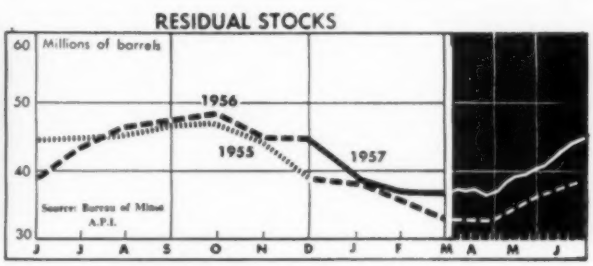
MIDDLE-DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



A.P.I. REFINERY REPORT—JUNE 28, 1957

(Thousands of barrels)

District—	Daily avg. runs	Daily average production— Gaso.*	Kero.	Dist.	Resid.	Stocks‡— Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, June 1956— Daily avg. runs	Daily average production— Gaso.*	Kero.	Dist.	Resid.
East Coast	1,306	548.3	31.1	351.8	247.1	42,370	11,138	39,333	11,004	1,149	440.0	35.3	290.5	193.1
Appalachian:														
District 1	101	46.0	2.9	22.9	5.4	5,098	536	2,400	473	109	43.8	2.6	27.8	5.0
District 2	45	29.1	1.6	8.0	6.1	2,604	475	804	290	95	53.4	4.8	13.8	12.7
Ind., Ill., Ky.	1,320	683.4	56.4	258.9	160.9	33,166	5,281	17,330	5,787	1,359	688.0	71.4	251.8	146.6
Minn., Wis., Dak.	105	49.9	8.0	29.4	10.6	6,345	872	5,080	395	93	45.6	7.7	25.2	6.9
Okla., Kans., Mo.	726	386.2	12.9	156.4	28.4	16,439	1,456	10,686	974	717	399.8	14.3	169.1	30.1
Inland Texas	275	212.1	7.3	59.4	21.9	7,306	385	2,200	1,815	280	207.5	6.4	51.3	22.2
Texas Gulf Coast	1,865	898.1	81.7	492.6	238.3	25,810	3,508	13,945	6,027	2,040	971.5	94.1	510.7	262.9
La. Gulf Coast	622	372.3	38.0	186.4	47.0	10,922	3,081	6,208	1,599	740	373.5	38.3	182.4	49.0
N. La. and Ark.	84	30.4	4.0	19.7	6.9	4,208	841	1,764	88	99	36.1	6.7	25.1	6.4
Rocky Mountain:														
New Mexico	29	13.6	0.7	4.9	3.1	374	11	74	65	23	12.1	0.2	4.4	3.4
Other Rockn Mtn.	291	138.0	3.1	66.9	40.0	7,185	256	2,894	1,175	286	135.2	4.1	63.3	33.1
California	1,146	498.2	7.0	162.3	334.6	26,696	372	12,279	14,970	1,081	473.2	4.2	139.3	327.0
June 28, 1957	7,915	3,905.6	254.7	1,819.6	1,150.3	188,523	28,212	114,997	44,662	8,071	3,879.7	290.1	1,754.7	1,098.4
June 21, 1957	7,859	3,901.9	270.7	1,678.7	1,102.3	189,225	27,975	110,282	43,885					
June 29, 1956	8,144	3,926.0	303.6	1,765.4	1,137.4	181,446	25,779	93,672	38,374					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
★ Regular (89 octane)	11-25-11.75
★ Premium (98 octane)	14.00-14.50
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.75-11.25
Regular (92 octane)	11.00-11.50
Premium (97 octane)	12.75-13.25
Premium (98 octane)	13.00-13.50
California (rack):	
Regular (88 octane)	13.1
Premium (96 octane)	15.1
Premium (98 octane)	15.2
Caribbean area (cargoes):	
Regular (87 octane)	10.875
Premium (93 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
Grade 26-70	4.0
Breckenridge:	
Grade 26-70	3.5

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16 lb. Prices for grades below 16 lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	9.75-10.25
Diesel oil (58 d.i. and above)	9.375-9.75
Distillate No. 1	9.375-9.75
Distillate No. 2	8.75-9.125
Gulf Coast (cargoes):	
Kerosine 41-43	9.375-9.75
Distillate No. 2	9.25-9.50
New York Harbor (barges):	
Kerosine 41-43	11.55
Distillate No. 2	11.05
Diesel fuel, 48-52 d.i.	11.35
Caribbean area (cargoes):	
Distillate No. 2	9.5

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
★ Residual fuel (max. 1% S)	$1.95-2.10
Gulf Coast (cargoes):	
Bunker C fuel	$2.65-3.00
New York Harbor (barges):	
Bunker C fuel	$3.10
Caribbean (cargoes):	
Bunker C	$2.55
California (rack):	
Bunker C fuel, Los Angeles	$2.85-3.00

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., v.i.	25.5
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	22.25
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	28
200 vis. neutral (180 at 100°), 25 p.t.	26

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour)
14-14.9	$2.67	....	....	....	....
15-15.9	2.71	....	....	....	$1.89
16-16.9	2.74	....	....	....	1.94
17-17.9	2.78	....	....	....	1.99
18-18.9	2.82	....	....	....	2.04
19-19.9	2.85	....	....	....	2.09
20-20.9	2.89	$2.75	....	$2.62	2.14
21-21.9	2.93	2.77	....	2.64	2.19
22-22.9	2.97	2.79	....	2.66	2.24
23-33.9	3.01	2.81	$3.44	2.68	2.29
24-24.9	3.05	2.83	3.46	2.70	2.34
25-25.9	3.09	2.85	3.48	2.72	2.39
26-26.9	3.13	2.87	3.50	2.74	2.44
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95	....	2.82	2.63
31-31.9	3.38	2.97	....	2.84	2.67
32-32.9	3.44	2.99	....	2.86	2.71
33-33.9	3.50	3.01	....	2.88	2.75
34-34.9	3.56	3.03	....	2.90	2.79
35-35.9	3.61	3.05	....	2.92	2.83
36-36.9	3.65	3.07	....	2.94	2.87
37-37.9	3.68	3.09	....	2.96	2.89
38-38.9	....	3.11	....	2.98	2.91
39-39.9	....	3.13	....	3.00	2.93
40 and up	....	3.15	....	3.02	2.95

*Includes Oklahoma, part of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low Cold test Gulf Coast. ‡Sour.

Effective dates: California January 17, 1957, east of California, January 3-January 10, 1957; Pennsylvania Grade, January 16, 1957.

Some crudes in North Central Texas and West Central Texas, are on the intermediate schedules.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.88
Middle District	4.70
Southwest Pennsylvania	4.41
West Virginia	4.23
Buckeye Grade	4.23
Zanesville Grade	3.27
Illinois Basin	**3.15**
Canada:	
Leduc-Woodbend	2.78
Redwater (Alta.)	2.67
Smiley (Sask.)	2.44
Pembina	2.65

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
★ San Joaquin, 41°-41.9°, Puerto La Cruz	3.34
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
Quiriquire, 16.5°-16.9°, Caripito	2.45
Lagunillas heavy, flat, Amuay or Las Piedras*	2.38
Bachaquero, flat, Las Piedras*	2.23

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$2.12
Iranian, 34.0°-34.9°, Bandar Masur	2.04
Iranian, 34.0°-34.9°, Abadan	1.99
Iraq, 36.0°-36.9°, Fao	2.00
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.85
Qatar, 39.0°-39.9°, Umm Said	2.19
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.69
Iraq, 36.0°-36.9°, Tripoli, Banias	2.69
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.75

TANKER RATES PER LONG TON

(Latest reported spot fixtures)

★ Gulf-U.S.N.H., clean (USMC—15%)	$2.42
★ Gulf-U.S.N.H., dirty (USMC—27.5%)	2.08
★ Carib.-U.K., dirty (Scale—10%) (29s. 3d.)	4.10
★ P.G.-U.S.N.H., dirty (USMC—50%)	6.35

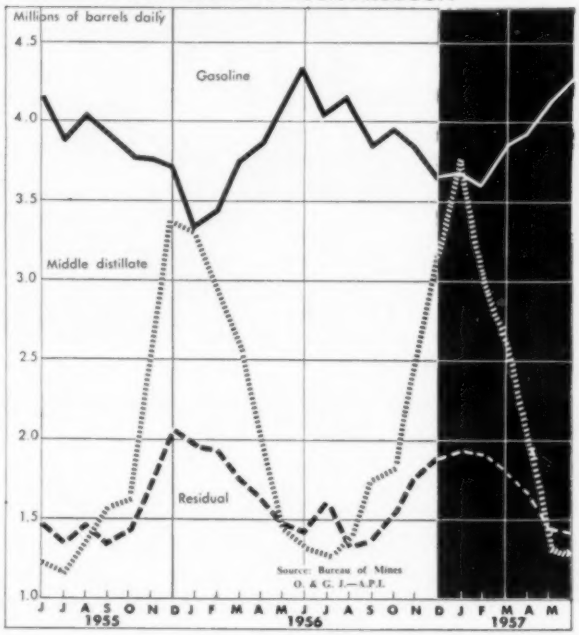
SUPPLY AND DEMAND—MAJOR PRODUCTS

(Thousands of barrels daily)

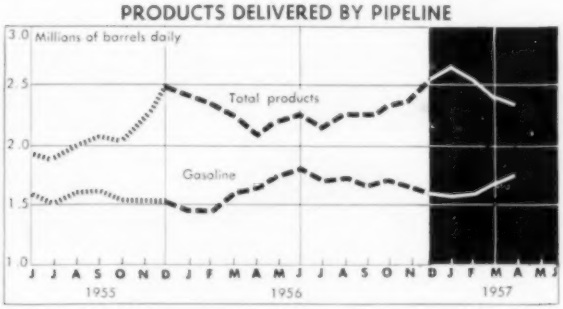
	Total demand	Refinery production	Stocks end of period†
GASOLINE			
June 1957*	4,250	3,925	188,000
May 1957*	4,070	3,840	195,290
April 1957	3,955	3,770	201,407
July 1956	4,018	3,878	176,536
June 1956	4,327	3,880	177,076
KEROSINE			
June 1957*	150	265	28,400
May 1957*	147	285	25,000
April 1957	246	284	21,512
July 1956	207	296	28,990
June 1956	153	290	26,111
DISTILLATE			
June 1957*	1,080	1,750	115,500
May 1957*	1,220	1,830	97,000
April 1957	1,709	1,764	78,743
July 1956	1,076	1,767	115,787
June 1956	1,180	1,755	93,758
RESIDUAL			
June 1957*	1,423	1,135	44,800
May 1957*	1,460	1,135	40,070
April 1957	1,700	1,132	37,429
July 1956	1,606	1,066	43,958
June 1956	1,412	1,098	39,073

*Preliminary. †Thousands of barrels.

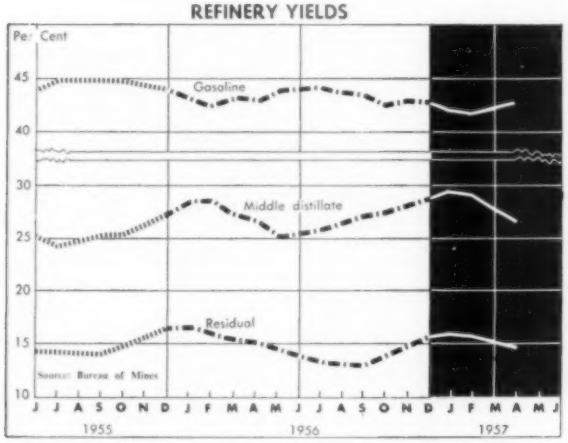
TOTAL DEMAND—MAJOR PRODUCTS



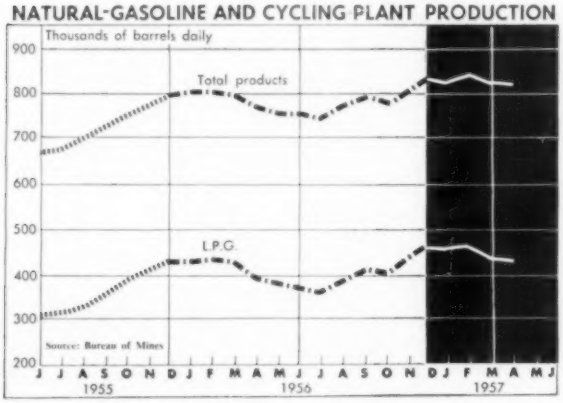
PRODUCTS DELIVERED BY PIPELINE



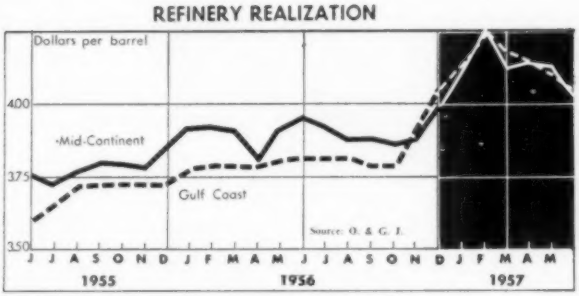
REFINERY YIELDS



NATURAL-GASOLINE AND CYCLING PLANT PRODUCTION



REFINERY REALIZATION



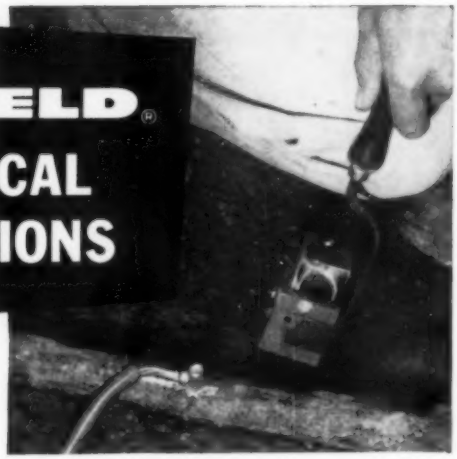
REFINERY REALIZATION

	June* 1957	May* 1957	April 1957	June 1956
Mid-Continent	$4.03	$4.13	$4.08	$3.95
Gulf Coast	4.05	4.10	4.15	3.81

*Preliminary.

Refinery realization is based on yields of major products and average spot prices of regular gasoline, kerosine, No. 2 fuel, and residual as published in The Oil and Gas Journal.

CADWELD® ELECTRICAL CONNECTIONS



play a vital part in any cathodic protection system

The quality of protection from rectifiers, anodes, cable, etc., in any CATHODIC PROTECTION INSTALLATION is only as good as the electrical connections used in the system.

The Electrical Connections must last the life of the installation while maintaining 100% ELECTRICAL EFFICIENCY. Any increased resistance in the connections, makes the system partially or totally useless.

Why take a chance . . . specify CADWELD ELECTRICAL CONNECTIONS and be sure.

Send for Bulletin 656-10, plus New Sheet on CADWELDING TO CAST IRON PIPE

656-10 C1XF-19

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Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED
3571 Dundas St. West
Toronto 9, Ontario

ERICO PRODUCTS, INC., 2070 EAST 61st PLACE, CLEVELAND 3, OHIO

1. Send Bulletin 656-10 . . . . . ☐
2. Send Bulletin C1XF-19 . . . . . ☐
3. Send name of local Dealer . . . . . ☐

NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____

Successful Wildcats

COLORADO

Logan County: Don Rounds et al 1 Elenz, SE SE 21-12n-52w. IPP 75 BOPD, "J" sand discovery, new field. TD 5,270 ft. "J" sand.

Weld County: Petroleum, Inc. 1 Peterson, C SW SE 29-12n-57w. IPP 175 BOPD, "D" sand discovery, new field. TD 6,765 ft. "J" sand.

ILLINOIS

Effingham County: Perry Fulk 1 A. M. Woody, SE SE SW 14-6n-6e. IPP 113 BOPD, 4 BWPD, Rosiclare 2,711-22 ft. TD 2,809 ft. Extension to Eherle pool.

Marion County: National Associated Petroleum Co. 1-A Ververs, NE NE NW 18-3n-1e. IPP 82 BOPD, Trenton 3,946-80 ft. TD 4,052 ft. New pay in Fairman pool.

INDIANA

Gibson County: D. P. Sturgeon 1 A. Riggs, NW NW SE 17-2s-11w. IPP 5 BOPD, 8 BWPD, Penn. 850-60 ft. TD 892 ft. Extension to West Princeton pool.

Pike County: Coy Oil Co., Inc., 1 E. Richardson, NE NE SW 19-1s-6w. IPP 60 BOPD, 40 BWPD, Aux Vases 1,123-29 ft. TD 1,227 ft. Opens Whiteoak field.

KANSAS

Barber County: Petroleum, Inc., 1 Kirkbride, NW NW SW 21-32s-12w. IPP 140 BOPD, 70 BWPD, 852 M.c.f. of gas per day, Miss. 4,384-4,405 ft. TD 4,475 ft. Opens East Forsyth pool.

Edwards County: Smitherman Drilling Co. and Sunray Mid-Continent Petroleum Corp. 1 Embry, 24-24s-16w. IP 2,700 M.c.f. gas per day, Kinderhook 4,215-36 ft. TD 4,610 ft. Opens East Embry pool.

Graham County: Cook & Galloway Drilling Co. 1 Toll, SW SE SW 5-8s-25w. IPP 43 BOPD, 35 per cent water, 41°, Lansing-Kansas City 3,952-57 ft. TD 4,022 ft. Opens Northwest Schmied pool.

Harvey County: Bennett & Gould 1 Kreibel, SW SW SE 23-22s-2w. IPP 20 BOPD, 10 BWPD, 32.6°, Viola 3,386-94 ft. TD 3,515 ft. Opens South Sperling pool.

Meade County: James Donoghue 2 Fox, C NE SW 36-33s-30w. IP 2,800 M.c.f. of gas per day, Morrow 5,790-5,830 ft. TD 5,879 ft. New pay in Novinger field.

Stafford County: Alpine Oil & Royalty Co. 1 English, SW NE SE 29-25s-14w. IPP 116 BOPD, 4 per cent water, 32°, Lansing-Kansas City 3,905-15 ft. TD 4,300 ft. Opens Emerson pool.

Kingman County: Petroleum, Inc., 1 Stevens, NE NE SW 19-30s-6w. IPP 71 BOPD, 65 per cent water, 32.5°, Miss. 4,170-78 ft. TD 4,730 ft. Opens South Reida pool.

MANITOBA

Dome-Canadian Superior 5-24 North Virden, LSD 5, 24-11-26w1. Lodgepole oil discovery. TD 2,012 ft.

MONTANA

Teton County: Good 1-1 Bills, NW NE 1-27n-7w. IPP BOPD, Sawtooth discovery, new field. TD 3,400 ft. Madison.

NEBRASKA

Banner County: Pan American Petroleum Corp. 1 State I, C SW SW 16-17n-55w. IPP 130 BOPD, "J" sand discovery, new field. TD 6,510 ft. "J" sand.

SASKATCHEWAN

Imperial-Canadian Superior 4-31 Parkman, LSD 4, 31-9-33w1. Mississippian oil well. TD 3,660 ft.

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BESSEMER GAS COMPRESSORS—3 type 10 twins direct connected units—Boswell-Frates Company, 1003 Kennedy Building, Tulsa, Oklahoma.

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Two—6'0" Diameter x 93'1" long
Shell 1¼"—Heads 1½"
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Suitable for Process or LPG Storage
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We are discontinuing our contracting business and have two rigs, now on contracts. One rig for 7,500 foot wells and one for 3,500 to 5,000 foot wells.

If interested in purchase, can furnish inventory and can inspect rigs while operating.

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H & H DRILLING COMPANY
Phone MUrray 2-2032,
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FOR SALE OR RENT: One GBLU 4" x 11" Oil Well packaged gas compressor. One "HB" 5¼" x 13" HOMCO packaged gas compressor. Alfred B. Kern, 305 Kennedy Building, Tulsa, Okla.

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7000 FT. 3½ I.F. modified drill pipe; 4⅝ tool joints; elevators; rotary slips; and six (6) 5¾ drill collars. Box 297, Tyler, Texas.

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5—Packed Towers 14" x 40', 18" x 23', 160# Wyatt 1950.
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3 Pacific ITB, 400 gpm.—2,000' hd. 735 gpm—3,100' hd.
5 Pacific SVTB, 612 gpm—600' hd. 324 gpm—480' hd, 308 gpm—516' hd, 193 gpm—389' hd.
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BJ hot oil pump 3 x 9, 13 st, 325 gpm, 4600' hd.

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1 Worth LTC-6 800 hp.
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HOT OIL PUMP—PACIFIC 8 STAGE CENTRIFUGAL SS LINED TYPE ITB 2½" 334 GPM @ 1000 PSI 750° F. 312 BHP

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Two 5½" x 8" Gardner-Denver skid mounted, G.M. Diesel Powered, Duplex Slush Pumps.

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6200' 2⅞" Grade D, Range 2, 10.3#, I.F., API., Drill Pipe.

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In addition there is ample Elevators, Slips, Tongs, Subs, Weight Indicators, Swivels, Kellys, Mud Gauges, Oxy. & Acetylene Welders, Overshots, Taps, Light Plants, Water Pumps, Water Lines, Water Tanks, Connections, Fuel Tanks, Drill Collars, OCT Blow-out Preventer, Spare Parts, Pick-up Trucks, Hand Tools, etc.

This equipment is ideal for stratigraphic drilling, oil, gas, or water production, or injection to 2000' or more. It is in good condition, ready to drill.

We will furnish complete descriptive inventory on request.

Box K-261, The Oil and Gas Journal, Tulsa, Oklahoma.

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HELP WANTED

PROCESS ENGINEER. Supervisory opening in operations as Unit Foreman to right man with 4 or 5 years refinery experience. Furnish record of education and experience. Box K-213, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

SALES REPRESENTATIVE for oilfield supply firm to call on district offices. Must have oilfield supply and tubular products experience. Probably presently employed. Western Kansas area. Salary open. Write P. O. Box 2205, Tulsa, Okla.

PETROLEUM ENGINEER. Intermediate size oil company operating West Coast, Mid-Continent, Gulf, and Rocky Mountains has opening for graduate engineer with minimum 3 years experience of reservoir, production, completion techniques. Location West Coast. Please furnish details of scholastic record, experience, and qualifications in resume form. Replys will be kept confidential. Box K-264, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

REFINERY ENGINEER for independent company located in Kansas. Project estimating, design and drafting experience. Give detailed resume of education, experience and salary expected. Box K-226, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPLORATION DIRECTOR
(South America)

Expanding young diversified oil company has on opportunity in South American country for a man qualified to direct program of exploration. Must have broad training and experience in geology, geophysics, and exploration drilling preferably in Latin America. Speaking knowledge of Spanish essential. Age to 50. Salary commensurate with experience and responsibility in our new foreign operation. Send complete personal history including experience and education to:

Box K-259, The Oil and Gas Journal,
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An opening exists for an experienced equipment engineer to be assigned to our Division Petroleum Engineering Staff located in Houston, Texas. Applicant must be highly competent in the application of all phases of production equipment.

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Salary commensurate with ability and experience. Age limit 40.

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D. V. Carter, Chief Petroleum Engineer, Petroleum Engineering Department

MAGNOLIA PETROLEUM COMPANY
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has opening for graduate Petroleum or Chemical Engineer involving above ground petroleum losses. Applicants should preferably be between 28 and 35 and should have a minimum of 5 years field experience in the production fields, natural gasoline plants or gathering line systems. The position is permanent, located in New York City, with some travel involved.

Submit full particulars in resume form together with salary requirements. All replies will be held in strict confidence.

Box K-225, The Oil and Gas Journal,
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All information confidential.
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For Caracas, Venezuela

CHEMICAL ENGINEERING DEGREE.
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EXECUTIVE ASSISTANT

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Box K-263, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEERS
GEOPHYSICISTS
(South America)

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Liberal Employe Benefit Plans. Salary commensurate with experience.

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QUALIFICATIONS:—
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HELP WANTED

FOREIGN EMPLOYMENT. List oil companies, drilling contractors, seismograph contractors, showing where apply foreign jobs, $5.00 cash. OIML Co., Box 2603, Tulsa, Okla.

PETROLEUM ENGINEERS. Independent oil company has openings in West Texas, Northern and Central Louisiana for graduate petroleum engineers under 35 years of age, with knowledge of field production problems, work-overs, completions, and water flood operations. Replies confidential. Send resume with small photo and transcript of college credits to P. O. Box 2162, Dallas 21, Texas.

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Excellent growth potential for an analytical chemist, M.S. or Ph.D. with five years experience in analytical methods. Man would assume responsibility for setting up program of rountine analytical testing, corrosion testing and research methods in Product Development laboratories, Houston, Texas, location.

Send resumé and salary requirements to:

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Crude Oil and Natural Gas

Headquarters In New York City

Experience in crude oil, natural gas buying or in geological exploration. Knowledge of marketing of oil field products or in application and use of oil or gas in a refinery, natural gasoline plant, condensate plant, pipeline company, engineering office . . . valuable.

- Exceptional opportunity for advancement to management
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Qualified applicants may expect replies within a month. Please send resume to

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REFINERY SUPERINTENDENT desires connection with refining or petrochemical company. Twenty years experience with proven administrative ability in all phases modern refinery operations. Excellent references. Box K-256, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOPHYSICIST: Age 30, veteran, B.S. degree in geology. Five years experience in Rocky Mountain area and Canada. Some Gulf Coast experience. Desires position with small company or independent. Box K-222, The Oil and Gas Journal, Tulsa, Oklahoma.

DRILLING SUPERINTENDENT. Age 34. Graduate Engineer. Married 10 years experience in Drilling and Production work wants job with drilling contractor or small production company. Box K-250, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

PETROLEUM ENGINEER: Age 34, single, B.S. General Engineering and Chemical Engineering; 2½ years domestic and 6½ years varied experience drilling and completion with major in South America. Desire domestic or foreign employment. Box K-258, The Oil and Gas Journal, Tulsa, Oklahoma.

STRUCTURAL ENGINEER: M.S. 5 years experience with major American Oil Co. overseas. Good general knowledge of the oil business. Familiar with planning, supervision of design, procurement of materials, and construction of industrial and oil facilities. Age 28, single. Box K-262, The Oil and Gas Journal, Tulsa, Oklahoma.

CONSULTING GEOLOGIST: Albuquerque, New Mexico. B. S. Degree, 6 years' experience all phases of exploration, development, land, drilling deals in West Texas, New Mexico, Four Corners Area, Julesburg Basin, and Wyoming. Desires retainer-interest position with active operator. Good references. Jack Q. Frizzell, 7114 Central, S. E., Albuquerque, New Mexico.

PETROLEUM GEOLOGIST - SUPERVISORY: Seventeen years combined experience; 12 years East Texas, Arkansas, Louisiana, Mississippi, and Southeastern United States. Extensive background in exploration, development, and evaluation at management level. Widely known, good standing and reputation, excellent references. Wish to relocate. Available immediately. Will consider Canadian or domestic employment. Box K-252, The Oil and Gas Journal, Tulsa, Oklahoma.

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MORE LOGS ARE FILED in Kraftbilt Strip Log Cabinets than all others combined. Loaded drawers glide smoothly on roller bearings. Three drawers per section, add sections as needed. Built to last a lifetime! Send for Catalog 57-B, Ross-Martin Co., P. O. Box 800-A, Tulsa 1, Okla.

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HIGHEST PRICE PAID for oil and gas income royalties, overrides, oil properties. A. S. Berry, 520 Wright Bldg., Tulsa, Oklahoma.

LEASE AND DRILLING BLOCKS

OIL AND GAS MINERAL LEASES available in Dell City area of Hudspeth County, Texas. U. S. Geological Survey Map shows anticlinal axis nearby favorable for oil-gas structure. Am fee landowner of over 2000 acres. Write quickly to: Jefferson G. Smith, 215 Littlefield Building, Austin 15, Texas.

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4-Corners Area. November Indian Lease sale brought 30 Million Dollars. Some leases sold for $3,200 per acre. Wells estimated up to 1500 barrels of oil per day. Oil Leases from $2.25 an acre. Fortunes being made. Write for free information now. ATLAS OIL SURVEY, Dept. OJ-7, Colorado Bldg., Denver 2, Colo.

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1,611 acres in Utah on U.S.D.S. services structure. $10 per acre for quick sale. For free geological map, call collect AC 2-1363 or write

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Delaware Corporations formed and serviced. American Guaranty & Trust Company, P. O. Box 487, Wilmington, Delaware

WANTED

WANTED—Oilfield sales and service organization to act as manufacturers representative for production equipment. Distributorships now available for California and Oklahoma. Box K-243, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED—Pipeline Flying. Commercial Pilot. Kansas, Oklahoma, or Texas. Chas. McAfee, Wellington, Kansas.

BEAT-UP TITLE MAN, haywire mechanic wants grup-stake. Box K-260, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION FOR SALE

CAN DELIVER 1,000 to 5,000 bbls. crude oil daily, low grade or regular in tank cars or in pipe line at Wyoming points. Producer, P. O. Box 2362, Denver, Colorado.

PRODUCTION WANTED

WANTED: Oil or gas production, any size prefer, Okla., N. M., Tex., Colo. or Kan. B Thurston, 1427 Princeton NE, Albuquerque N. M.

WANT TO BUY—Oil Properties, settled or semi-settled production. 100 to 5,000 barrels daily in Oklahoma and Kansas. Contact Morris Sitrin, 1215 First National Building, Tulsa, Oklahoma.

PRODUCING oil, gas properties, also royalties wanted. Any size, any amount. Complete details in first letter. Box 231, Scarsdale, N. Y.

BUSINESS OPPORTUNITIES

FUNDS AVAILABLE to drill 100 wells on proven acreage only. Detailed offers invited. Box 613, Fort Worth, Texas.

DRILLING CONTRACTORS able to make drilling contract in France wanted. Write to S.I.R.E.P. 19, Cours Pierre Puget, Marseille, France for information.

HEALTH FORCES sacrifice sale of this exceptional 11 year old $100,000 volume business! The company's permit allows owner to haul any material or equipment pertaining to oil or gas business. Centrally located in heart of gas and oil field area and fine farming, it is near state university and industries and oil refineries. Unlimited potential for go-getter. Dimit Trucking Co., Mount Pleasant, Mich.

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Enardo Manufacturing Co.

Box 1647 Tulsa, Okla.

LEGAL

U. S. instrust for Chitimacha Indians, offers oil and gas lease on 262.23 acres more or less, of tribal land in St. Mary Parish, State of Louisiana, known as Chitimacha Indian Reservation. Sealed bids to be opened at the Choctaw Indian Agency, Philadelphia, Mississippi at 10:00 A.M. Central Standard Time, Thursday, July 25, 1957. Invitations to bid and additional information concerning sale may be obtained from Choctaw Indian Agency, Philadelphia, Mississippi.

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Pipeline Patrol

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- **Israeli Government**

Project: A 6-in. line from the Haifa refinery to Tel Aviv.

Completion: Late 1957.

- **North Atlantic Treaty Organization (NATO)**

Project: 2,000 miles of lines to airfields in parts of Europe

Status: Under way

Contractor: **Associated Pipeline Contractors, Inc.** (450 miles from Iskenderun, Turkey to Batman); **TECHINT** (205 miles of 4-in. from Bandirma to Eskisehir, Turkey, and 250 miles of 8-in. from Antalya to Eskisehir).

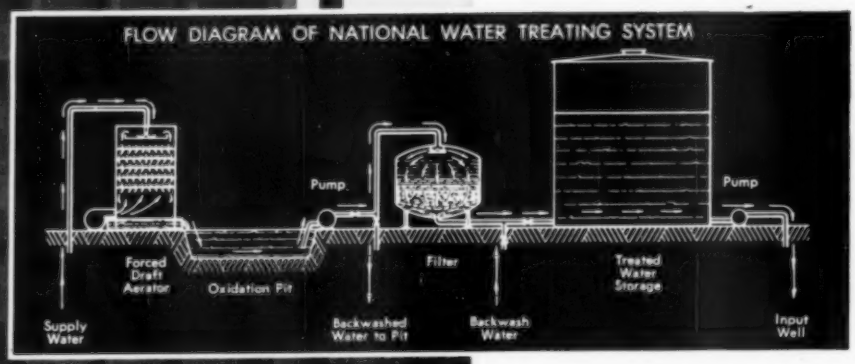
- **Yacimientos Petroliferos Fiscales** (Argentina).

Project: 497 miles from Mendoza to Buenos Aires.

Status: Proposed.

AERATION!

National Aerator for treating supply water or disposal water in open water system.



Two National Aerators in series with water supply well located north of Tulsa, Oklahoma.

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NATIONAL "OPEN SYSTEM"

Salt Water Treating

The National forced draft Aerator is fabricated of redwood with reinforced fiber glass distributor and splash trays, to facilitate ease of and reduce frequency of cleaning. Distribution of water from tray to tray assures liberation of water-bound gases which are expelled to the atmosphere by controlling the volume of air introduced at bottom of the Aerator.

Submerged Aerators are also manufactured by National as are complete closed and open water systems.

Our Engineering Department welcomes inquiries concerning your water disposal problems.

It's National®

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

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MEAN ELECTRIC WELD LINE PIPE PROVEN AND READY FOR OIL AND GAS PRODUCING AREAS

Here are the "Big 5" reasons why Youngstown Electric Weld Line Pipe is your best buy:

1. It bends readily
2. Wall thickness is uniform
3. Line up characteristics are excellent
4. Weldability is outstanding
5. Long lengths save you time and trouble

In the process of producing Youngstown Electric Weld Line Pipe, every means is explored to assure uniform wall thickness. Uniformity of wall in the pipe begins with control of the skelp thickness produced on the rolling mill. The experience plus control in the rolling of the skelp by men who know steel makes this uniformity possible. Youngstown as an integrated producer has full control over the skelp rolling as well as the finished pipe production. To test the uniformity and quality, the pipe is then placed in a hydrostatic testing machine where internal pressure is applied. To obtain Electric Weld line pipe of uniform wall thickness—specify Youngstown Electric Weld line pipe for your next pipe line job.

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Youngstown Electric Weld Line Pipe

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Manufacturers of Carbon, Alloy and Yoloy Steel

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Men who *know* tool joints specify Straight Grip from experience. Longer life, trouble-free operation, additional footage at less per-foot cost, plus the guarantee of satisfaction because it's American Iron.

When you make *your* next tool joint purchase, specify American Iron Straight Grip . . . you'll be buying experience and reliability.

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